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ANATOMICAL PLATES

OF

THE VISCERA.

EDITED BY JONES QUAIN, M.D.
AND W. J. E. WILSON.

F. 3/7a

QUAIN and WILSON

[Anatomical plates. Div. IV]

Variant issue with col. plates

Thos. J. Beard

THE

VISCERA

OF

THE HUMAN BODY;

INCLUDING

THE ORGANS OF DIGESTION, RESPIRATION, SECRETION, AND EXCRETION;

IN

A SERIES OF PLATES,

WITH REFERENCES AND PHYSIOLOGICAL COMMENTS.

EDITED BY JONES QUAIN, M.D.

AND

W. J. ERASMUS WILSON.

LONDON:

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This Publication consists of a Series of Anatomical Drawings, some original, others selected from monograph treatises or from systematic works. The highest place in the former class is deservedly conceded to the works of Scarpa and Tiedemann, and in the latter, to those of Mascagni and Caldani; but from their size and the style in which they are executed, the expense of publication is necessarily such as to confine their usefulness to comparatively few persons. It may, however, be fairly admitted, that the collections of Cloquet and Loder, though not of equal pretension, are no less valuable to students, as a guide to the knowledge of that complex fabric whose composition they seek to investigate; and to those of maturer age, as a means of reviving impressions received during their earlier studies. As, however, even the works last named, from their price, are inaccessible to some, and to others from the descriptions and references being given in a foreign language, the want of a similar publication in an English garb has been for some time complained of.

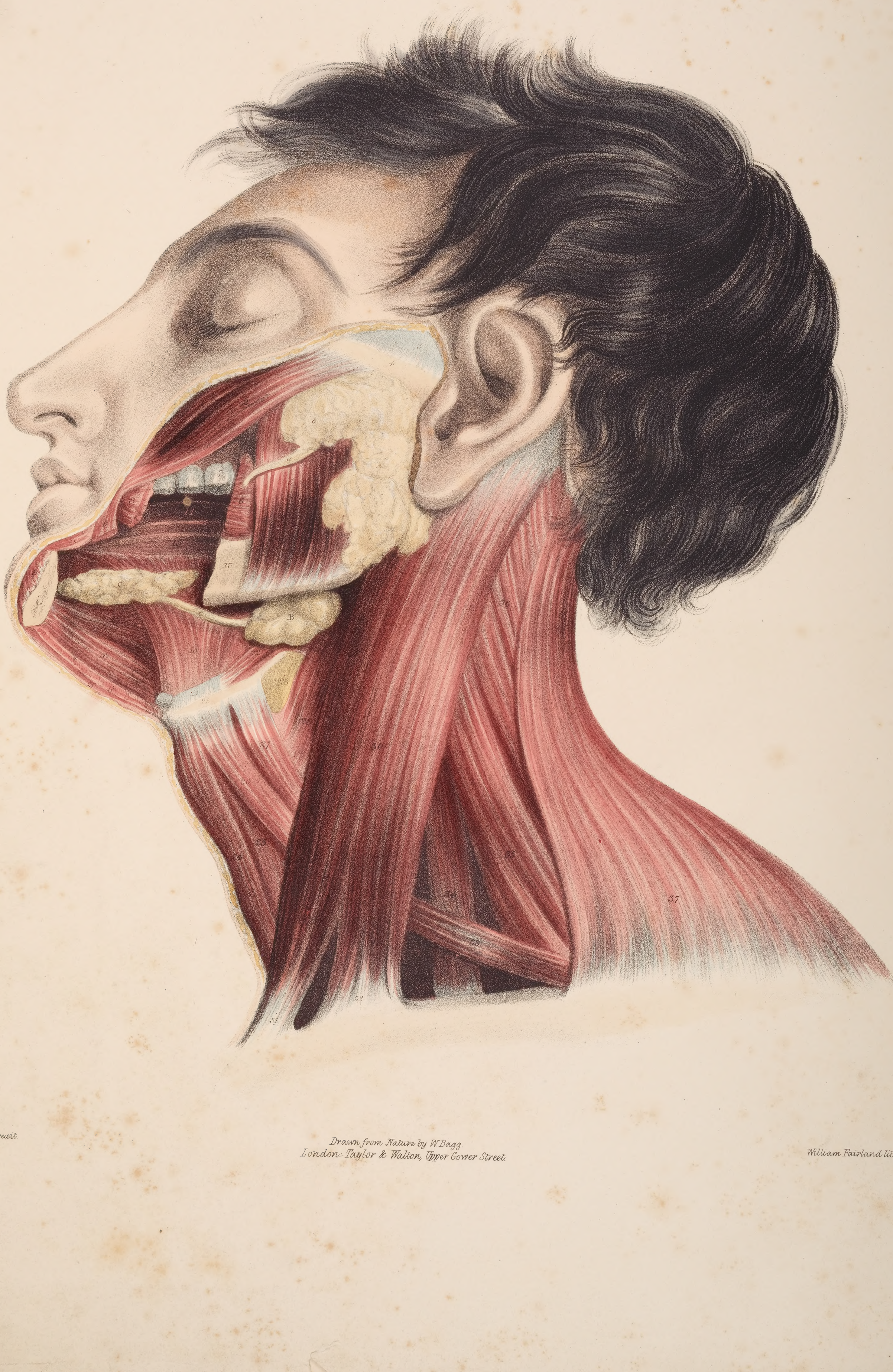
To supply the want here noticed, and at a moderate price, is the object of the present undertaking. The Plates are accompanied by letter-press, containing detailed references to the various objects delineated, the names being set down in English, Latin, and French. But with a view to render them intelligible to a greater number of persons, a running comment on each Plate is given, stating in general terms, the uses and purposes which the different objects serve in the animal economy. The drawings are taken on stone by Mr. W. Fairland from drawings by Mr. J. Walsh, and Mr. W. Bagg, and the printing executed by Hullmandel, Graff and Soret, and Fairland.

The Work consists of Five Divisions, as follows :

First.—The Muscles.
Second.—The Heart and Blood Vessels (Arteries and Veins), with the Lymphatic and Lacteal Vessels.
Third.—The Brain and Spinal Marrow; the Nerves and Organs of Sense.
Fourth.—The Viscera; including the Organs of Digestion, Respiration, Secretion and Excretion.
Fifth.—The Bones and Ligaments.

As the order in which the Divisions may appear is of secondary consequence, those are taken first which are most wanted by Students, and which are most interesting in themselves. The number of Plates will be about two hundred and Fifty.

Plate. 1.



J.F. Wilson direxit.

Drawn from Nature by W. Bagg.
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William Fairland lith

VISCERA OF THE HUMAN BODY.

THE viscera of the human body include the various organs which are contained in the three great internal cavities, viz. the head, the thorax, and the abdomen. The study of these organs constitutes that part of the science of anatomy which is named Splanchnology (σπλαγχνον, viscus).

The viscera of the head and spinal column are the brain and spinal cord, together with the principal organs of sense. These we have considered in the division upon the Nervous System, to which they more directly belong than to the viscera of the other cavities, which we are now about to examine.

The viscera of the chest are, the central organ of circulation — the heart; the organs of respiration—the lungs, and the thymus gland. The abdominal viscera are divisible into those which properly belong to that cavity, viz. the alimentary canal, the liver, spleen, and pancreas; and those of the pelvis—the bladder, and internal organs of generation.

In the description and delineation of these viscera, we shall pursue a physiological rather than an anatomical order, commencing in the first place with the organs of digestion, taking next those of respiration and the central organ of circulation; then proceeding to the organs for the secretion of urine, and lastly to the organs of generation.

The organs of digestion include the mouth and alimentary canal, consisting of the pharynx, œsophagus, stomach, small intestine, and large intestine,—the small intestine being apportioned into the duodenum, jejunum, and ilium, — and the large, into the cæcum, colon, and rectum. To these may be added the various glands which pour their secreted fluids upon the surface of the mucous membrane. The glands which are subservient to digestion are, the salivary and the various mucous

PLATE I.

In this plate the salivary glands are exhibited in their natural situations.

A. The parotid gland.

a. The duct of the parotid gland—Stenon's duct. b. The socia parotidis.

B. The submaxillary gland.

c. Its excretory duct—Wharton's duct.

C. The sublingual gland.

No. 1. The zigomaticus minor muscle seen beneath the divided edge of the integument. 2. The zigomaticus major. 3. The temporal fascia. 4. The zigoma. 5. The masseter muscle, overlapped by the parotid gland, and crossed by Stenon's duct. 6. A part of the buccinator, the rest having been removed with a part of the lower jaw in order to bring into view the cavity of the mouth and the side of the tongue. This portion of the buccinator is pierced by Stenon's duct. 7. The first molar tooth of the upper jaw. 8. A portion of the buccinator muscle at its insertion. 9. A small portion of the depressor anguli oris muscle. 10. The edge of the orbicularis oris muscle. 11. The cut edge of the muscles of the chin. 12. The cut surface of the body of the lower jaw. 13. The body of the lower jaw. The intermediate portion between 12 and 13. has been removed to show the position of the sublingual gland. 14. The dorsum of the tongue. 15. Fibres of the stylo-glossus muscle. 16. The hyo-glossus muscle crossed by Wharton's duct, and brought into view by the removal of the mylo-hyoideus muscle. 17. The genio-hyo-glossus muscle. 18. The genio-hyoideus muscle. 19. The divided edge of the mylo-hyoideus muscle. 20. The cut edge of the platysma myoides. 21. The pulley of the digastricus muscle. 22. The posterior belly of the digastricus muscle. 23. The os hyoides. 24. The sterno-hyoideus muscle. 25. The sterno-thyroideus muscle. 26. The superior belly of the omo-hyoid muscle. 27. The thyro-hyoideus muscle. 28. The thyro-hyoidean membrane. 29. The inferior constrictor muscle of the pharynx. 30. The sterno-mastoid muscle. 31. Its sternal origin. 32. Its clavicular origin. 33. The inferior belly of the omo-hyoid muscle. 34. The scalenus anticus muscle. 35. The scalenus posticus. 36. The splenius colli muscle. 37. The trapezius.

follicles and glands opening into the mouth, the tonsils into the fauces, the liver and pancreas into the duodenum, and the proper follicles and glands of the mucous membrane throughout its entire extent.

In the mouth is performed the process of *mastication*, through the agency of the teeth and of the muscles which move the jaws; while the salivary glands, mixing their secretion with the alimentary substances, conform the mass to a proper consistence and effect *insalivation*. *Deglutition* is conducted by the muscles of the fauces, soft palate, tongue, and pharynx, and by the muscular coat of the œsophagus, the surface of the canal being lubricated by the secretion of the mucous follicles and glands, particularly by the tonsils. In the stomach the ingesta are converted into a greyish pulp, constituting *chymification*. The chyme being conveyed into the duodenum and small intestines, is submitted to the action of the bile and pancreatic fluid which separate the chyle. This part of the process is named *chylification:* the chyle is taken up by the lacteals and conveyed by the thoracic duct into the current of the venous blood at the root of the neck, to be thence circulated through the capillaries of the lungs, where it is submitted to the action of the atmospheric air and converted into blood. The rest of the ingesta is passed onwards through the canal, while its nutritive parts are constantly absorbed by the lacteals which occupy every point of the surface of the mucous membrane. Reaching the large intestine, the ingesta undergo another change which is termed *fæcification*, and after being collected in the rectum, they are eventually removed entirely from the body by the act of *expulsion*.

Entering into the structure of the alimentary canal is a serous membrane, the peritoneum, the largest membrane of that class in the animal economy, and lining its interior, is a mucous membrane, a part of the general gastro-pulmonary mucous membrane.

Serous Membranes. — Serous tissue, or membrane, has several synonyms, viz. tissu séreux, membrana serosa, pellucida.—The structures included under this head are so named, because their surface is constantly moistened by a thin, albuminous fluid resembling the serum of blood; their form is that of a shut sac, without inlet or other interruption to its continuity. (Sacculi occlusi, "sacs sans ouverture.") — Each is a delicate membrane, smooth and homogeneous in its structure, and so thin as to be transparent, were it separated from the organs or parts with which it is in contact.

The recent researches of Henle* have shown that serous membranes, like mucous surfaces, are invested by an epithelium composed of stratified layers of vesicles and angular flattened plates, the former being situated nearest the membrane and the latter upon the surface. When first secreted, these bodies have the form of vesicles with central nuclei; but as they approach the surface, they gradually flatten and assume the form of thin plates, in the centre of which the nuclei are still perceptible. These bodies have been observed upon the serous membranes of the cavities of the body, on the lining membrane of the ventricles, internal lining of the heart, arteries, veins, and lymphatics, and upon some of the membranes of the eyeball.

A membrane which, if detached and distended, would resemble a bladder or a balloon (and such is the fact with regard to the serous membranes), necessarily presents two surfaces. Of these the inner one is perfectly smooth in its natural condition, and lubricated by a fine halitus exhaled upon it, which is occasionally accumulated and condensed into the fluid form. The external surface is rendered rough and flocculent by a number of cellular filaments, which pass off from it to the contiguous viscera, and form the means of its connexion with them. In this class we find grouped together several structures which agree in possessing the conformation and character here indicated, and in exhibiting, when diseased, nearly the same forms of organic change, though no direct communication subsists between them, and each of them is perfectly insulated from the others. The arachnoid membrane, which invests the brain, lines its cavities, and is, moreover, prolonged over the spinal cord, belongs to the class of serous membranes; so do the two pleuræ, which invest the lungs, and the proper pericardium, which encloses the heart; likewise the peritonæum, which is reflected over the different viscera of the abdomen, and the two processes which extend from it upon the testes (tunicæ vaginales). The membrane which lines the anterior chamber of the eye and secretes the aqueous humour, is of the same structure; so is that which encloses the vitreous humour, viz. the hyaloid membrane, and also the capsule of the crystalline lens. The inner or lining coat of arteries and veins presents several points of similitude to those here enumerated.

As serous membranes are thus placed within the great cavities of the body, and as they line the inner surface of their walls, and surround, at the same time, to a greater or less extent, the contained

* Müller's Archiv. für Anatomie und Physiologie, &c. No. 1, 1838.

parts, anatomists recognise in each of them two portions,—one *investing* the viscera, the other *reflected* upon the walls of the cavity. Thus, in the pericardium, one part of the serous membrane encloses the body of the heart, extends for some way on the great vessels, and then passes off to line the fibrous bag which retains that organ in its situation; so that it forms a single sac, one part of which is doubled within the other. This is strictly true with regard to the pericardium; it is not less so in the case of the peritonæum and arachnoid membrane, though from their extent, and the great complexity of their arrangement, it is not at first sight easily perceived. It is the investing part of serous membranes which gives to different organs their shining appearance; and as it is very thin, their colour, form, and even the minute inequalities of their surface, are distinctly seen through it, as we observe when examining the heart, brain, lungs, &c. Though these structures appear destitute of fibres, or of any assignable internal organisation (being what Haller considered them, merely condensed cellular tissue), still, if any part of them be inflamed, vessels will be traced into their tissue. It requires some care to determine this point with precision; for the vessels which ramify in the subserous cellular web will often appear to run in the membrane itself, when in reality they are external to it.

Serous membranes allow a considerable degree of distension during life, as we see in cases of dropsy, and in the state of pregnancy, also in herniæ; and they retract slowly when the distending cause is removed. They exhibit no animal sensibility in their natural condition, but acute pain arises when inflammation is excited. They confine to fixed positions some organs, for instance, the large intestine, the liver, and stomach; in others, as the small intestines, they facilitate movement by means of the smoothness of their surface and the fluid which they secrete. By being reflected from one viscus to another, they necessarily, in the intervening spaces, form folds, in which the vessels are conveniently lodged, and by which they are in a manner guided to the organs which they supply. It must be evident that these membranes cannot completely invest at every part any of the organs with which they are in contact; each of them will be left uncovered at the points of reflection, and there the vessels can enter them without piercing the membrane, or interrupting its continuity. The folds or duplicatures of peritonæum, termed omenta, mesentery, meso-cola, afford illustrations of what has been here stated. There is but one exception to the general principle above indicated, viz. that serous membranes form shut sacs, without interruption to their continuity or external communication. It occurs at the free, or, as it is technically called, "fimbriated," border of the Fallopian tubes in the female; for there, the serous investing layer is continuous with the mucous lining, and is necessarily open, to give passage to the ovum.

Are serous membranes furnished with exhalent vessels to pour out the fluid which moistens them, and with absorbents to take up the surplus or residue of it? The existence of such vessels cannot be demonstrated; it has been assumed, in order to account for the effusion and absorption of fluids, which, until lately, were conceived to be inexplicable on any other hypothesis. It is now, however, clearly demonstrable, that fluids and gases can pass through organised membranes without being conducted across them by exhalent vessels. If a piece of membrane, or, what will answer better, if the cæcum of a common fowl, containing a few drachms of milk, of a solution of gum Arabic, or of common salt, be suspended in a glass filled with water, it will be found that in a few hours the water has entered the intestine, and ascended within its cavity until it overflows at the top. But if the mode of experimenting be altered,—if, whilst the intestine is filled with pure water, the fluid in which it is suspended be rendered specifically heavier by the addition of any saline substance, the direction of the current will be reversed; it will flow outwards from the interior of the membrane. Thus, in the former case, there is a passing into the interior of an organised structure, which M. Dutrochet calls *endosmosis* (ενδος, inward; ωσμος, effort); in the latter, the tendency is in the opposite direction, therefore called *exosmosis* εξω, outward; ωσμος). But though the stream seems thus to run altogether from the rarer to the denser fluid, yet we find that a minor current exists in the opposite direction. If a solution of prussiate of potash be enclosed within the intestine, endosmosis takes place rapidly, and at the same time exosmosis goes on, but in a slight degree, which may be proved by adding a few drops of muriate of iron to the external fluid, when it will be found to have received some of the salt of potash. Gases also percolate membranes, and in a determined direction.* If a bottle, with a wide mouth, be filled with carbonic acid, and closed at top with a layer of Indian rubber, exosmosis will occur; for the membrane will become depressed into the glass, showing that the carbonic acid escapes out of it, though it has to go contrary to its gravity. If the experiment be reversed, by placing, under a receiver

* Faust and Mitchell. American Journal of Medical Sciences, No. 13.

filled with carbonic acid, a bottle containing atmospheric air, closed in by a membrane, endosmosis will occur; for the cover becomes distended and elevated, showing that the carbonic acid has a tendency to pass in that direction in which the atmospheric air is placed. Mere gravity or density does not determine the direction of the current. The chemical composition of the substances employed appears to exert an influence on the result; so also does the galvanic agent.

Mucous Membrane.—The internal tegument, or mucous membrane, is differently named by writers, tissu muqueux, Bichât; membrana mucosa, villosa, mucipara.—The tegumentary membrane is not confined to the external parts of the body; it is prolonged into their interior, where it serves a corresponding purpose; but in this situation it presents some important modifications in its character; and, from the nature of the fluid which covers and moistens it, receives the name of "mucous membrane." From the lips and nares, it extends along the whole length of the alimentary canal, as well as into the different follicles and excretory ducts which open into it. The larynx, trachea, bronchi, and air-cells of the lungs, are lined in the same way by a mucous membrane; and, as the whole forms a continuous surface, it has been named by Bichât, the "*gastro-pulmonary mucous membrane.*" A similar mucous surface may be traced from the orifice of the meatus urinarius, along the urethra, bladder, and ureters, to their termination in the tubuli of the kidney; also into the vasa deferentia, from which it is probably continued into the tubular structure of the testes in males. In the female, it is prolonged from the vagina into the uterus, and thence into the Fallopian tubes to their termination. This continuous tube forms the "*genito-urinary mucous membrane.*"

Between the two great divisions of the internal tegument here pointed out, no organic connexion or communication exists. The general form of each may be said to be that of a canal, or tube, of considerable extent, but presenting numerous contractions and dilatations, corresponding with those of the hollow organs which they line. Their external surface is rough and flocculent; for it is attached by cellular tissue (sub-mucous) to the contiguous textures. The strength and closeness of its adherence varies in different parts of its extent. In the stomach it is easily separated; from the pylorus to the ilio-cæcal valve it gradually becomes more firmly attached, at the valve itself it is less so; but in the large intestine it is again very closely adherent, and so continues to the rectum, near the extremity of which it is comparatively loose. The thickness of the membrane also varies; it is greatest in the stomach and duodenum, and thence diminishes gradually towards the lower part of the small intestine; at the ilio-cæcal valve it increases somewhat; it becomes thinner again along the large intestine (being about half as thick as in the stomach); but it increases perceptibly towards the extremity of the rectum. Its firmness and power of resistance are greatest in the stomach and duodenum, which seems to depend on its greater thickness in these parts.

The colour of the mucous membrane varies in different parts of its extent; to which circumstance, in a great degree, is owing the discrepancy we find amongst writers upon this point. Béclard says it is white, with a reddish tinge; Boyer, that it is yellowish grey, becoming red in the stomach,

PLATE II.

Anatomy of the mouth, the mucous glands, and the development of the parotid gland.

Fig. 1. The mouth held widely open.

Nos. 1, 1. The upper lip drawn upwards by a hook. 2. The frænum of the upper lip. 3. The four incisor teeth of the upper jaw. 4, 4. The canine teeth of the upper jaw. 5, 5. The bicuspid teeth of the upper jaw. 6, 6. The two anterior molares of the upper jaw, the third did not exist in this subject. 7, 7. A bristle inserted into the duct (Stenon's) of the parotid gland, which opens into the mouth opposite the second molar tooth of the upper jaw. 8. The palate marked by transverse elevations. 9, 9. The soft palate. 10. The uvula. 11, 11. The anterior arch or pillar of the soft palate. 12, 12. The posterior arch or pillar. 13, 13. The amygdala or tonsil. 14, 14. The pharynx. 15, 15. The dorsum of the tongue. 16. The apex of the tongue. 17. The frænum linguæ. 18, 18. Two bristles inserted into the openings of the ducts (Wharton's) of the submaxillary glands. 19, 19. Small openings of the sublingual ducts. 20, 20. The three molar teeth of the lower jaw. 21, 21. The two bicuspid teeth of the lower jaw. 22, 22. The canine teeth of the lower jaw. 23, 23. The incisor teeth of the lower jaw. 24. The frænum of the lower lip. 25. The lower lip.

Fig. 2. The inner surface of the lips showing the numerous small glandular bodies, labial glands which are situated immediately beneath the mucous membrane.

Fig. 3. A branch of the parotid gland from a fœtal calf highly magnified, and intended to display the structure of the salivary glands. The artery is injected with size and vermilion.

a. The artery. d. The duct. c. The cæcal terminations of the duct.

Plate 2.

Fig. 3.

Fig. 1.

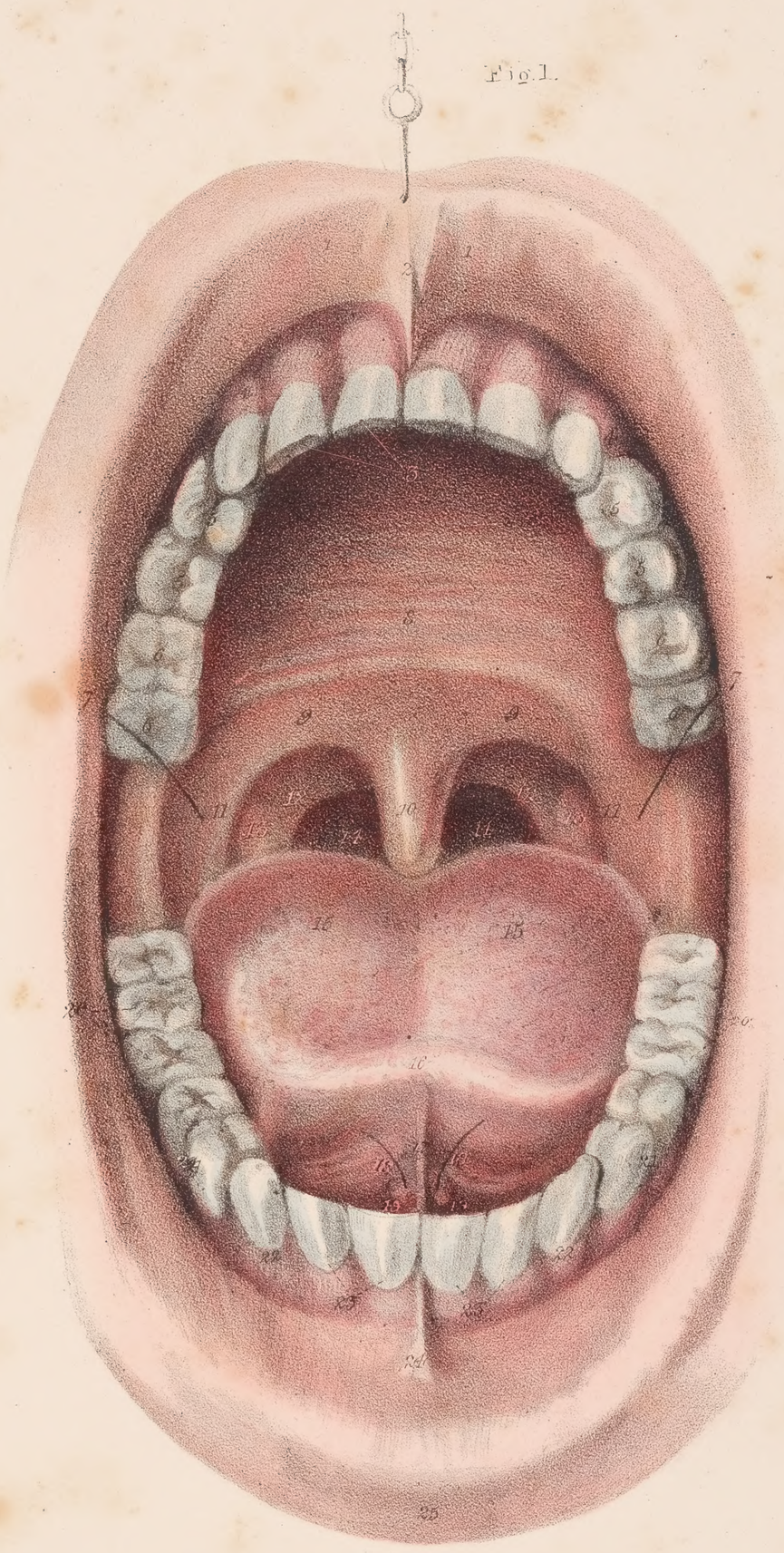

Fig. 2.

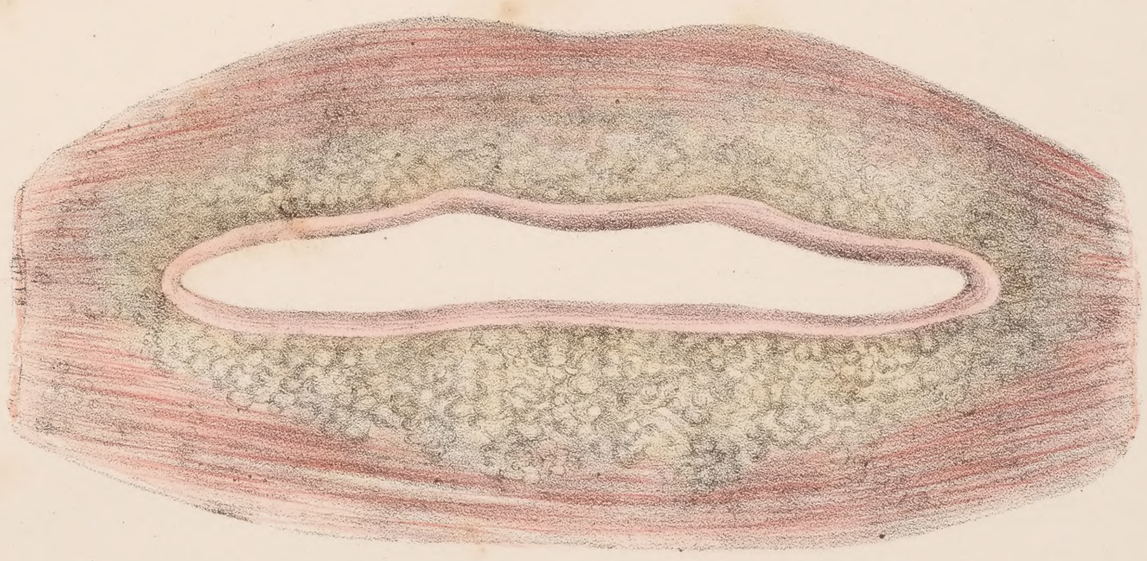

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Plate. 3.

Fig. 1.

Fig. 2.

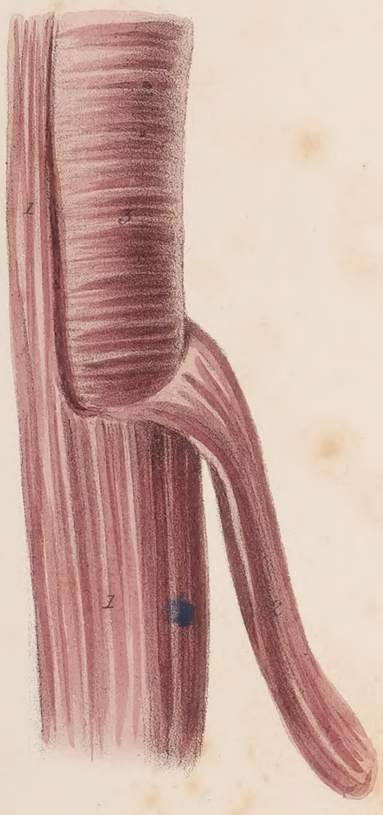


Fig. 3.

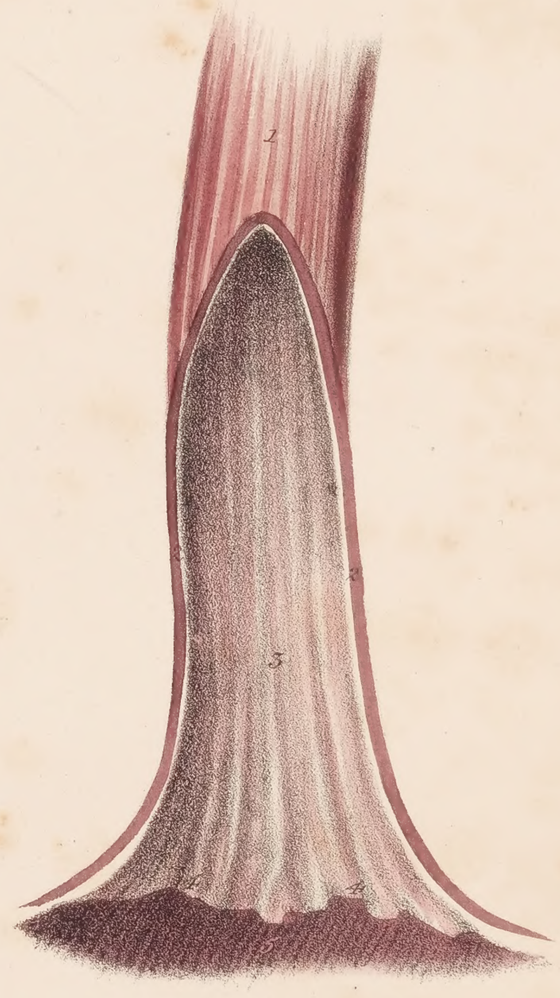
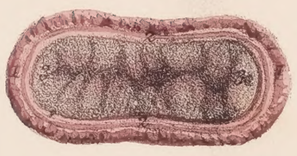


Fig. 4



W. J. E. Wilson, direxit.

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and reddish in the intestine; Gavard states it to be greyish, with an inclination to red. These statements are too general; for we find that the colour of the membrane is influenced by the age of the individual, by the circumstances which preceded his death, the condition of the thoracic viscera, by the time which has elapsed between death and the performance of the examination, and by the position in which the body has been laid. Hence arises the necessity of distinguishing that which is inherent in the membrane, from what is extraneous to it. For this purpose, a small piece must be carefully dissected off, and held up to the light; it will be found homogeneous, translucent, and of a pale white colour, or greyish, with a delicate rosy tinge. This is the healthy colour and condition of the membrane, when examined by itself after death; and if we inspect the intestine in a subject that has died without disease or disturbance of the abdominal viscera, we perceive, from the outside, some branching vessels creeping beneath the peritonæum, in a direction from the attached to the free border of the tube: a similar appearance will present itself from within, owing to the vessels lying in the submucous cellular tissue. During life, the vessels being necessarily more or less distended with blood, impart a tinge to the surrounding textures; and so the mucous membrane is rendered of a delicate rosy red, varying in degree according to the quantity of fluids circulating in a given part at any particular time. Hence it deepens in the stomach during the digestive process, and this deeper tinge creeps along the intestine as the alimentary mass passes from stage to stage during its progress; for the afflux of blood thus determined now to one point, now to another, carries with it the colour by a sort of derivation.

Plicæ, or *rugæ*.—The inner surface of the mucous membrane presents several inequalities (elevations and depressions) which deserve notice. In the stomach and in the bladder, when cut open, we observe numerous small ridges running in various directions, giving it an areolar aspect: these are termed rugæ; but they are not permanent; they arise from a contraction of the muscular fibres, and consequently disappear when the viscus is distended. In the œsophagus similar folds exist, but all running longitudinally.

Valvulæ conniventes.—In the small intestine we find folds which are permanent in their existence

PLATE III.

The anatomy of the pharynx and œsophagus.

Fig. 1. The pharynx laid open from its posterior part, in order to show the foramina which open into it.

No. 1. Basilar process of the occipital bone, which has been divided by a section carried transversely through the base of the skull. 2, 2. The posterior clinoid processes of the sphenoid bone. 3, 3. The anterior clinoid processes. 4, 4. The lesser wings of the sphenoid. 5, 5. The greater wings. 6, 6. A section through the squamous portion of the temporal bone. 7, 7. Divided surface of the petrous portion of the temporal bone. 8, 8. The carotid canal. 9, 9. The condyles of the lower jaw. 10, 10. The rami of the lower jaw. 11, 11. The divided edges of the pharynx drawn outwards. 12, 12. The posterior nares. 13. The posterior border of the vomer covered by mucous membrane, separating the posterior nares. 14, 14. The openings of the Eustachian tubes. 15, 15. The posterior extremities of the inferior spongy bones. 16. The soft palate, upon the middle line of which is seen a slight elevation formed by the projection of the azygos uvulæ muscle beneath the mucous membrane. 17, 17. A slight elevation of the mucous membrane, marking the direction of the levator palati muscle. 18. The uvula. 19, 19. The opening of the fauces. 20, 20. The arches of the soft palate. 21, 21. The anterior arches formed by the projection of the palato-glossus muscle at each side. 22. The posterior arches formed by the palato-pharyngeus muscle at either side. 23, 23. The tonsils. 24. The root of the tongue, marked by numerous elevations corresponding with mucous follicles. 25. The epiglottis. 26. The lateral frœna epiglottidis. 27. The opening into the larynx. 28, 28. The aryteno-epiglottidean folds of mucous membrane. 29. The convexity formed by the larynx. 30, 30. Two slight projections corresponding with the ascending cornua of the thyroid cartilage. 31. The opening into the œsophagus. 32, 32. Longitudinal folds formed by the mucous membrane of the œsophagus. 33. The œsophagus marked by its longitudinal fibres. 34. The trachea divided transversely.

Fig. 2. A portion of œsophagus, showing its muscular fibres.

No. 1. The external, or longitudinal fibres. 2. A part of the layer of longitudinal fibres turned down from the circular layer. 3. The internal, or circular fibres.

Fig. 3. The lower part of the œsophagus, a portion having been cut out for the purpose of showing the lining of mucous membrane.

No. 1. The exterior of the œsophagus, marked by longitudinal fibres. 2, 2. The divided edges of the œsophagus. 3. The mucous lining thrown into longitudinal folds. 4, 4. The terminal margin of the cuticular epithelium of the œsophagus. 5. A part of the stomach.

Fig. 4. A transverse section of the œsophagus, showing it to be closed in the contracted state of the muscular coat.

Nos. 1, 1. The external, or longitudinal layer of muscular fibres. 2, 2. The internal, or circular layer. 3, 3. The lining membrane thrown into folds which close the cylinder of the œsophagus.

and fixed in their direction, showing that they depend, not on the contraction of the muscular coat, but on the special conformation of the mucous membrane itself. These are termed *valvulæ conniventes*, and are formed of duplicatures, or narrow plaits of the membrane placed transversely with regard to the axis of the canal, and projecting into its interior. None of these extend round the whole circle—few reach farther than one third of its circumference. Some depart a little from the transverse direction, becoming rather oblique; and a few, of minute size, may be observed to run longitudinally, intersecting the spaces enclosed by those which are larger. When the membrane is detached, and stretched a little, the valves are unfolded and disappear, as the sub-mucous cellular tissue which connects them is torn asunder. The point at which the valvulæ commence is at about an inch below the pylorus, where they are rather small and but slightly projecting; but they gradually increase in size and breadth from thence down to the middle of the jejunum, where they project inwards about two lines; but they gradually diminish along the ileum, and cease at its lower end, a few oblique or longitudinal lines alone remaining. The term "plica" would better express the character and mode of formation of these projections than "valvula;" for they are merely folds of the membrane, which enlarge the extent of surface by which it comes into contact with the alimentary mass, and increase its absorbing power. The true valves are the ilio-cæcal and the pylorus; for they are contractile (muscular fibre entering into their composition), and exercise an influence on the course of the aliments. The term "valve" is also applied to three or four projecting and permanent ridges which exist in the interior of the rectum.* We shall recur to these when treating of the pelvic viscera.

Villi.—All the elevations hitherto noticed are readily perceived, even on a cursory inspection; they are easily shown in a piece of intestine inflated, dried, and then laid open, or, without any preparation, by merely laying it open; there are others which require a little more attention in order to be distinctly seen. If the mucous surface be held up to the light, or allowed to float in water, it will be found covered with a vast number of minute downy processes, giving it a flocculent appearance. Some persons have likened this to the pile, or soft surface of velvet; and hence arose the term "villi," by which the projections are known. Their intimate structure has been made the subject of much minute examination, and of not a little controversy; perhaps arising from the opinion, so very generally entertained, that absorption of chyle was effected by the capillary attraction of lacteal vessels, and that the open mouths of these must be placed in the villi. Lieberkuhn concluded (*Dissert. Anat. pathol. de fabricâ et actione villorum intestinorum tenuium hominis*), from his microscopical researches, that each villus consists of a capillary lacteal vessel, and a nerve with a delicate vascular plexus spread upon the lacteal, which becomes expanded into an ampulla immediately after its origin, in the form of a minute pore. Sheldon, Cruickshank, and Hewson, admit generally the existence of a lacteal with vessels and nerves in each villus; but deny the existence of any expansion or ampulla in its interior. We cannot feel surprised at any difference of opinion which may exist concerning the intimate structure of such minute objects, when we find that their outward form is said by some to be round, by others to be conical; whilst a third likens it to a mushroom with a stalk and pileus. All agreed in admitting an absorbing orifice at the extremity of each villus, whatever discrepancy may have existed upon other points. Béclard (*Anat. Générale*), however, after repeating the observations previously made by others, found that these projections are neither conical, tubular, nor expanded at the summit; but that they appear as so many plates, folia, or leaflets, set closely together, and forming a tufted pile. This is the true account of the matter: most of the antecedent observations bear evidence of being undertaken and conducted under the influence of a preconceived opinion as to the mechanism of absorption. There no longer remains any necessity for admitting the existence of pores, ampullæ, or capillary attraction, in order to account for the phenomena. Membranes we know to be permeable by fluids, and in a determinate direction; it matters little, then, whether, with Majendie and Fodera, we adopt the term imbibition to express the fact; or, with Dutrochet, name it endosmosis.

Mucous Follicles.—Along the alimentary canal we find, in various parts, minute orifices leading into small follicles, or shut sacs, which appear to be merely depressions into, or inversions of, the mucous membrane. They are embedded in the sub-mucous cellular tissue, and can therefore be readily seen upon the external or attached surface of the mucous lining, if it be carefully dissected away. Their capacity is generally small; in some parts they are simple in their structure, detached, and scattered, as we see in the stomach and duodenum, where they are named glandulæ Brunneri. Towards the lower part of the ileum, and even higher up along the jejunum, they are clustered together into spots

* Observations on the Mucous Membrane of the Rectum, by Dr. Houston, Dublin Hospital Reports, vol. v.

(glandulæ aggregatæ, glandulæ Peyeri). In some situations, several follicles open into a common dilated orifice, as into the lacunæ of the urethra and rectum, or into the foramen cæcum at the back of the tongue: finally, several follicles, by being united into bundles of various forms, constitute a compound secreting organ, with ramified ducts or lacunæ, as we see exemplified in the tonsils, the prostate and Cowper's glands. All these structures come under the general head "mucous follicles," for they have been supposed to secrete the fluid which moistens the surfaces upon which they open. But it is more probable that mucus, like synovia and the serous halitus, is produced by every part of the membrane, and that the follicles elaborate each a distinct product. The secretion of the prostate gland appears to differ as much from that of the tonsils, as the cerumen of the ear does from the sebaceous matter exuded upon the glans penis, or clitoris.

The *structure* of the internal tegumentary membrane resembles that of the external or true skin, so far as that it consists of a corium or dermis, and an epidermis, which is here called epithelium (επι, upon; θηλη, a nipple or papilla); for, when traced inwards from the margin of the lips, it is found to cover the papillæ on the surface of the tongue. A rete mucosum cannot be demonstrated in any part of it. The corium is soft, cellular, and spongy, varying in thickness and density in different parts, as we have already stated. The epidermis is prolonged upon its surface for some way, and may be traced as far as the union of the œsophagus with the stomach. The vagina also is similarly coated as far as the neck of the uterus; but the deeper-seated parts appear to be protected, not by an insensible epidermis, but by a softer and more delicate epithelium.

The epithelium of mucous membrane is composed of several layers of minute bodies, which have a laminated arrangement upon the surface of the membrane. These are best observed, according to Henle,* upon the conjunctiva, where the layers are clearly distinguishable. The layer immediately in contact with the mucous membrane consists of minute cells or vesicles, having each a central nucleus; but, as we approach the surface, the cells become flattened and assume an angular form. The nucleus is still perceptible, and the minute scales resulting from the flattening of the cells have the appearance of a tesselated pavement. In the mouth the arrangement of these bodies is precisely similar, but the scales are of larger size. In the alimentary canal they are lengthened and conical, and placed perpendicularly to the surface, the apices of the cones being in contact with the mucous membrane, and the bases forming by their juxtaposition the surface of the epithelium; like the preceding, they are provided with a central nucleus. On the surface of the mucous membrane of the nasal passages, of the larynx, trachea, and lungs, and of the vagina and uterus, another kind of scale is observed to compose the epithelium. It is cylindrical in form, like those of the intestine; and possesses, like them, a central nucleus. Upon its obtuse extremity are a number of minute cilia, which probably continue in constant motion during life, and diffuse the secretion equally over the surface of the membrane. According to Henle, the number of cilia upon each of these "ciliary cylinders" varies from three to eight.

Organs of Digestion.—The digestive organs consist of a primary or fundamental part, the alimentary canal, and certain accessories, which are in a manner appended to it. Under this head are included the salivary glands (sublingual and submaxillary, parotid and pancreas), the liver, and the spleen. Though the canal (*canalis cibarius*) forms one continuous tube, from its commencement at the mouth to its termination at the anus, it presents numerous modifications in its dimensions and form in different parts; moreover, as one portion of it is lodged at the base of the skull, another in the neck and thorax, and a third in the abdomen, it becomes necessary to treat of each separately. To avoid unnecessary subdivision, we shall consider it as composed of two parts, one above the diaphragm, the other below it. The first division includes the organs of mastication and deglutition; the second, those of digestion properly so called, and of defæcation.

The Mouth.—The space included between the lips (*labia*) and the throat (*fauces*) is called mouth (plate II.: *os; cavum oris*). Its roof is the palate, its floor the tongue, its sides the cheeks (*buccæ*). Immediately within its external aperture (*rima*) are the dental arches. All these parts are coated with a mucous membrane, which has been already described. In the present section, therefore, it remains for us to notice some folds which are formed by its reflections, and which, from some assumed resemblance to check ligaments, have been called *frœna*. Inside each lip, at the middle line corresponding with the symphysis of the jaw-bones, a small vertical fold (fig. 1, Nos. 2. 24) is placed (frænum labii superioris et inferioris). One of larger size (fig. 1, No. 17) extends from the under surface of the tongue downwards and forwards (frænum linguæ); when the point of the tongue is raised, the form of this fold is triangular, its base being forwards. At the root of the tongue we

* Symbolæ ad anatomiam villorum intestinalium, imprimis eorum epithelii et vasorum lacteorum. Berlin, 1837.

observe another, extended backwards from its upper surface upon the epiglottis (frænum epiglottidis). Most of the constituents of the other parts here enumerated have already been noticed; the muscles of the lips and cheeks, those of the palate, and of the tongue.

*The Tongue.**—The tongue (plate II. fig. 1. 15, 16; lingua) is not only the proper organ of taste, but, by means of its great mobility, assists other parts in deglutition, in speech, in suction, &c. Its upper surface, or dorsum, is convex in its general outline, and marked along the middle by a slight groove, or raphé, which divides it into two symmetrical parts. About a quarter of an inch from its base will be observed a round hole (*foramen cæcum*), which forms a sort of reservoir for some of the mucous follicles placed in considerable number in that situation. We speak of its point or anterior narrowed extremity, of its sides, and of its base, which is in intimate connexion with the os hyoides. Upon its upper surface we find several projecting points, or *papillæ*, differing so far in size and number as to admit of being arranged as follows:—1. *Papillæ lenticulares*, which vary in number from ten to fifteen, are disposed in two lines, converging to an angle just before the foramen cæcum. They are rounded on their free surface, and resemble so many inverted cones, their summits being embedded in the substance of the tongue. 2. *Papillæ capitatæ*, vel *fungiformes*, are more numerous than the preceding, and also smaller. They are placed, for the most part, towards the borders and point of the tongue. They present each a rounded head, supported by a short thin pedicle. 3. *Papillæ conicæ*, vel *pyramidales*, are much more numerous than the others, and are diffused over the whole of the dorsum of the tongue, from the lenticular papillæ to its point. They are minute and tapering. A fourth class has been recognised by some persons (*papillæ filiformes*), but they are very few, and placed close to the apex of the tongue. The papillæ at the point and sides consist of the ultimate terminations of the gustatory nerve, surrounded by a delicate vascular plexus, and supported by cellular tissue.

Structure.—Beneath the mucous membrane is placed a thin but firm lamella of condensed cellular tissue, approaching in its characters to elastic tissue. If all the muscles ordinarily described as belonging to the tongue be dissected away, a considerable mass of fleshy substance will still remain, the fibres of which appear interlaced in such a way as to be with great difficulty traced. Upon the upper surface and sides of the tongue a thin stratum of fleshy fibres is placed, extending longitudinally from behind forwards. At the under surface, the fibres of the linguales muscles run in the same way, but that they form fasciculi, not a layer. If the genio-hyo-glossi be carefully dissected to their insertion, their fibres will be found to turn outwards, or to become blended with others which pass transversely from the raphé to the borders on each side. Both the planes of fibres here noticed

* The plates illustrative of the anatomy of the tongue are contained in Division III. upon the Nervous System and Organs of Sense.

PLATE IV.

In this plate is seen the alimentary canal, removed from the abdomen, and separated from its connexions.

A. The stomach.

No. 1. The œsophagus. 2. The great, or cardiac extremity of the stomach. 3. Its lesser, or pyloric end. 4. A constriction corresponding with the pylorus. 5. The superior, or lesser curve of the stomach. 6. Its inferior, or greater curve.

B. The duodenum.

No. 7. Its ascending portion. 8. Its descending portion. 9. Its transverse portion. 10. The termination of the pancreatic duct opening into the descending portion of the duodenum near its inferior angle. 11. The termination of the ductus communis choledochus in the duodenum. 12. The ductus communis choledochus. 13. The common hepatic duct formed by the union of the right and left hepatic ducts. 14. The cystic duct. 15. The gall-bladder.

C, C. The small intestine.

No. 16. The upper part of the jejunum where it is continuous with the duodenum. 17, 17. The jejunum. 18, 18. The ileum, of a lighter colour than the jejunum. 19. The termination of the ileum in the large intestine.

D. The cæcum.

No. 20. The cul-de-sac of the cæcum. 21. The appendix vermiformis, connected with the cæcum by a delicate mesentery, 22.

E. The ascending colon. F. The transverse colon. G. The descending colon.

Nos. 23, 23. The longitudinal bands of muscular fibres which produce the peculiar sacculated character of the colon.

H. The sigmoid flexure of the colon. I. The rectum, in which the sacculated appearance is lost.

No. 24. Some of the longitudinal muscular fibres seen upon the rectum. 25. The sphincter ani.

Plate. 4.

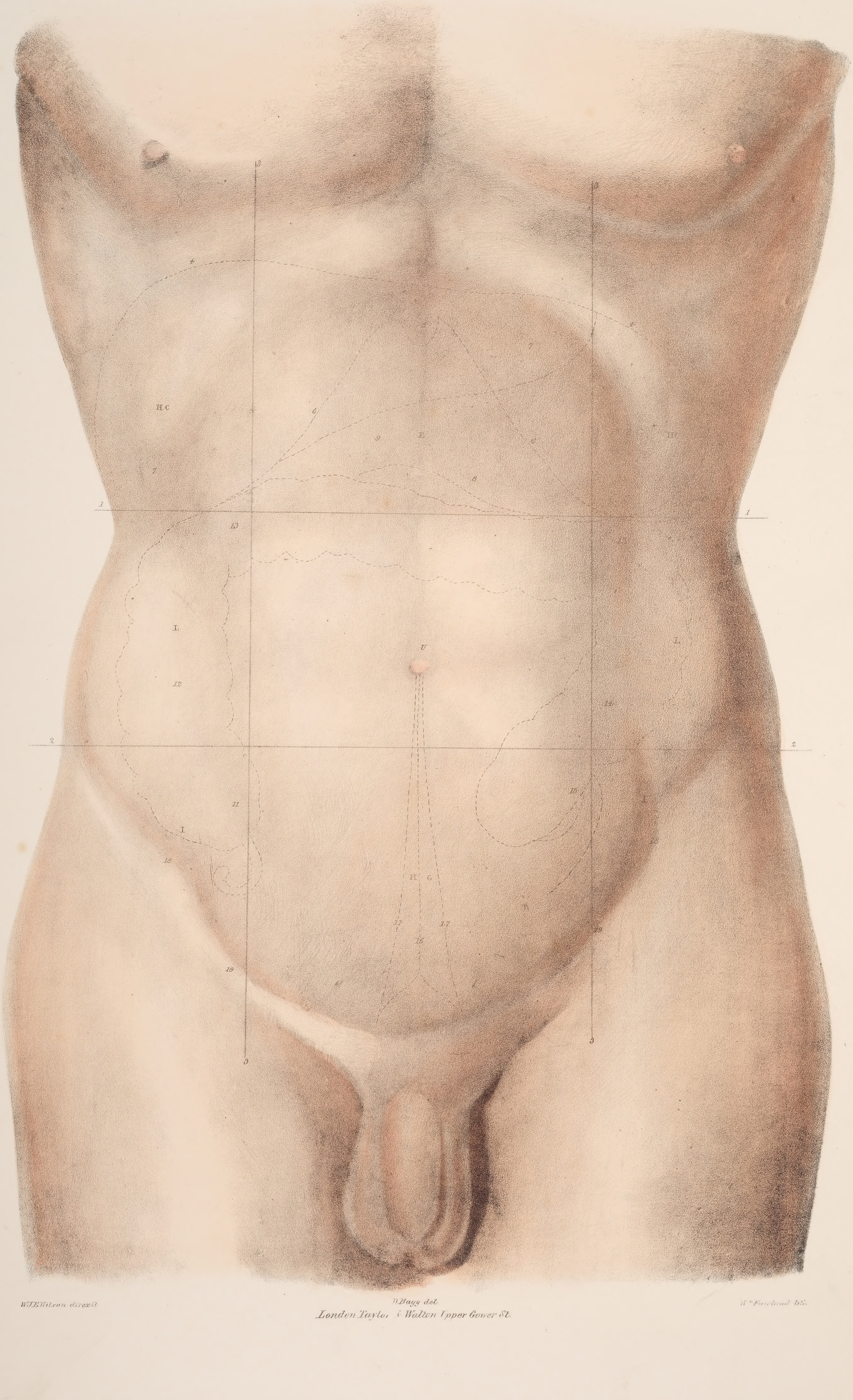
W. J. E. Wilson direxit.

Drawn from Nature by W. Bagg.

London. Taylor & Walton, Upper Gower Street.

Will.m Fairland lithog.

Plate 5.



W.J.E.Wilson direxit

W.Bagg del.

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W.m Farland lith.

are placed horizontally, one being at the upper, the other at the under surface; a third set seems to connect them, by passing vertically from one to the other.

The Soft Palate.—The soft palate (plate II. fig. 1, Nos. 9, 9; plate III. fig. 1, No. 16: *velum pendulum palati*) forms a partial and movable curtain between the mouth and the pharynx. Its upper border is straight, and attached to the margin of the palate bones; the lower is divided into two parts by a conical depending process, called *uvula* (plate II. fig. 1, No. 10; plate III. fig. 1, No. 18). From this, as from a common point of departure, two curved lines (plate II. fig. 1, Nos. 11, 12) will be observed to extend at each side, one proceeding downwards and forwards to the side of the tongue, the other backwards to the pharynx; both being named, from their form, the arches of the palate. In the angular interval left by their divergence is lodged the tonsil, or amygdala; the anterior arch is also called the *isthmus* of the fauces, as it marks the narrowed interval between the mouth and the throat, or pharynx. The soft palate consists of five pairs of muscles enclosed by the mucous membrane.

Amygdala (plate II. fig. 1, No. 13; plate III. fig. 1, No. 23).—Between the arches of the soft palate, on each side, is lodged an elongated oval structure, about the size and shape of an almond, from which circumstance it is termed *amygdala;* in common language it is called *tonsil:* it seems to be composed of a great number of mucous follicles aggregated together into a mass. Its internal surface presents several small apertures, which lead into follicles, or cells, that secrete a mucous and viscid fluid. It is of a reddish grey colour, and exceedingly vascular. Before it, is the palato-glossus muscle; behind, the palato-pharyngeus: internally, the mucous membrane; externally, the stylo-glossus.

Salivary Glands.—Three secreting organs, belonging to the class of conglomerate glands, are placed at each side in the region now under consideration, viz. the parotid, submaxillary, and sublingual glands. They differ in size and situation, but agree in being of a pale ash-colour, also in being composed of minute lobuli aggregated into bundles and lobes, and in secreting the salivary fluid, which is conveyed into the mouth by ducts that arise by radicles from the granular structure of each gland.

The Parotid Gland.—The parotid gland, (plate I, A; παρα, near; ους, ωτος, the ear,) so called from its position with regard to the ear, is the largest of these. Its superficial extent is from the zygoma to a level with the angle of the jaw and mastoid process, and from the meatus externus of the ear and anterior margin of the mastoid process to the ramus of the jaw and masseter muscle, being also prolonged upon the latter by a process which accompanies its duct, and thence named *socia parotidis* (b). The external surface of the gland is covered by the skin, and partially by the platysma muscle, and bound down by a prolongation of the cervical fascia. Its substance projects deeply towards the base of the skull, filling up the interval between the ramus of the jaw and the mastoid process, and necessarily maintaining various and complex relations with nerves and vessels therein situated. Thus, one process of it fills up the posterior part of the glenoid cavity, another passes behind and between the styloid muscles; a third, covered by the ramus of the jaw, rests against the pterygoideus internus. Through its substance pass the external carotid artery, with its accompanying vein, also the facial nerve; and close to its internal or deep-seated surface are placed the internal carotid artery, together with the internal jugular vein. Considering the complexity of these relations, is it possible in the living subject to dissect out the body of the gland and its various deep-seated processes? The duct

PLATE V.

The regions of the abdomen.

Nos. 1, 1. A line drawn from the most prominent point of the cartilages of the ribs of one side to that of the opposite side. 2, 2. A line drawn from the most convex part of the crest of the ilium on one side to the same part on the opposite side. 3, 3. Two lines drawn perpendicularly downwards from the cartilage of the eighth rib to the middle of Poupart's ligament.

E. The epigastric region. HC, HC. The hypochondriac regions. U. The umbilical region. L, L. The lumbar regions. HG. The hypogastric region. I, I. The iliac regions.

4, 4. The line of the convexity of the diaphragm. 5. The situation of the ensiform cartilage. 6, 6. The line of the inferior margin of the thorax. 7, 7. The situation of the liver marked by dotted lines. 8, 8. The situation of the stomach. 9. The situation of the pylorus. 10. The situation of the spleen. 11. The cæcum. 12. The ascending colon. 13, 13. The transverse colon. 14. The descending colon. 15. The sigmoid flexure of the colon. 16. A dotted line marking the course of the urachus. 17, 17. The course of the umbilical ligaments. 18, 18. The anterior superior spine of the ilium. 19, 19. The line of Poupart's ligament marking the groin.

of the gland (a; *ductus Stenonis*) arises by minute radicles in the lobuli (plate II. fig. 3), and taking a transverse course passes forwards on the masseter muscle, and pierces the buccinator muscle, and the mucous membrane of the mouth, opposite the second dens molaris of the upper jaw. The duct is accompanied by a process of the gland already noticed: it is composed of two tunics, the external one being thick and fibrous in its structure; the internal one is a mucous lining prolonged into it from that of the mouth, and, though it appears some lines in diameter, its calibre will barely admit a thin wire. Its direction across the face may be indicated by a line drawn from the lower margin of the concha of the ear to midway between the red margin of the lip and the ala of the nose.

The Submaxillary Gland.—The submaxillary gland (plate I. B) lies behind and beneath the ramus of the jaw, resting on the mylo-hyoideus muscle, and separated from the parotid gland by the stylo-maxillary membrane, where it is covered by the skin and platysma, and invested by a thin lamella of cellular membrane. The facial artery runs in a groove on its upper surface. A process of the gland turns round the posterior border of the mylo-hyoideus muscle, lying beneath the mucous membrane. Its excretory duct (c) is called *ductus Whartoni*, though it was known before that anatomist's time: in its passage to the mouth, it at first inclines backwards, to reach the posterior border of the mylo-hyoideus muscle; after which it runs forwards and inwards along the side of the hyo-glossus and genio-hyo-glossus muscles, towards the side of the frænum of the tongue, where it terminates.

The Sublingual Gland.—The sublingual gland (plate I. C) is much smaller than the others, and of an oval form. As its name implies, it lies beneath the tongue, close to the side of its frænum, resting against the genio-hyo-glossus muscle, supported by the mylo-hyoideus, and in close contact with the duct and deep process of the submaxillary gland. Its secretion is poured into the mouth by several minute orifices (plate II. fig. 1, No. 19) which open beneath the tongue on each side. Sometimes one or two small ducts join with that of the submaxillary gland.

The Pharynx.—The pharynx (plate III. fig. 1; fauces, throat) is a musculo-membranous bag, extended from the centre of the base of the skull as far as opposite the fifth cervical vertebra, where it becomes continuous with the œsophagus. Its superior wall or roof consists of the osseous structure just named (lined by mucous membrane), and its sides and back part of three pairs of flat muscles (constrictors), with two pairs of accessories, stylo-pharyngeus and palato-pharyngeus. It is more expanded in the middle than at its extremities, of which the lower one gradually tapers, so as to represent a funnel, when in connexion with the œsophagus. Its posterior surface rests against the spinal column; its sides are included between the great cervical vessels; anteriorly, it communicates with the nose by two apertures (12, 12; posterior nares); with the mouth through the palatal arch (19, 19; isthmus faucium); lower down with the larynx, by the glottis (27); laterally with the tympanal cavities of the ears, by the Eustachian tubes (14, 14); and inferiorly is continued into the œsophagus (33).

The Œsophagus.—The œsophagus (plate III. fig. 1, No. 33; figs. 2, 3, 4: οισω, feram; φαγω, edo) is a musculo-membranous tube, extended from the pharynx to the stomach. It is the narrowest part of the alimentary canal, being about an inch in diameter; and, though far less curved than any other, it is not perfectly straight. As it lies along in front of the spine in the neck and thorax, it necessarily presents a slight concavity forwards in the latter region, corresponding with that of the spine. Besides this, it has two slight lateral curves, for its commencement lies upon the median line; further down, towards the root of the neck, it inclines to the left side; but, thence to the fifth dorsal vertebra, it gradually resumes its position in the middle line; finally, when approaching the diaphragm, it deviates again to the left, at the same time coming forward to the foramen œsophageum of the diaphragm. The œsophagus is closely applied to the anterior surface of the vertebral column, being merely separated from it superiorly by the longus colli muscle, lower down by the thoracic duct, and towards its lower extremity by the aorta. In the neck it lies immediately behind the trachea, but, inclining to the left side, comes into relation with the left carotid artery: in the chest it is concealed by the remaining part of the trachea and by the pericardium. The cervical portion has on each side the common carotid arteries; in the thorax, the aorta, except near the diaphragm, lies to its left side, and the vena azygos to the right; here the œsophagus is partially covered by serous membrane lying in the interval between the pleuræ (posterior mediastinum).

Structure.—The œsophagus consists of a muscular or external coat, and of a mucous lining. While in the thorax it receives its arteries from the aorta (r. œsophagei), in the neck from the inferior thyroid artery. The branches of the nervus vagus form a plexus upon it; and, superiorly, the recurrent nerve is in close relation to it. Its muscular coat consists of two sets of fibres, forming distinct

planes, and taking different directions. Those of the external layer (plate III. fig. 2, No. 1) are well marked, all disposed longitudinally in the direction of its axis, and of considerable thickness; the inner fibres (No. 3) run in the opposite way, so as to form rings or circles round the tube: near its extremities they are quite transverse; in the intervening space they are somewhat oblique. At the commencement of the œsophagus its muscular fibres are blended with those of the pharynx, the circular set being, as it were, a continuation of the lower border of the inferior constrictor. But the longitudinal fibres present a peculiarity which deserves attention: they are disposed in three fasciculi; one at each side, which is blended with the inferior constrictor; and one in front, which is attached to the cricoid cartilage at the prominent ridge, between the crico-arytenoidæi muscles. At the lower extremity of the œsophagus its fibres become blended, or rather continuous, with those of the stomach. The lining membrane is continuous superiorly with that of the mouth and nose, inferiorly with that of the stomach; it is pale, but dense and firm. It presents several slight longitudinal folds, which disappear when the tube is distended. Its inner surface is coated by a prolongation of the epidermis, which can be recognized as far as the cardiac orifice of the stomach.

The part of the alimentary canal which is beneath the diaphragm consists of the stomach and intestines. Previously to describing them, it is necessary to notice the conformation of the cavity in which they are contained, viz. the abdomen.

The Abdomen.—The abdomen (*abdere*, to conceal) is the largest cavity in the body.

Its extent and boundaries.—It extends from the diaphragm, which forms its upper boundary, to the levatores ani; and from the transversales muscles in front, to the spine, quadrati lumborum, and iliaci, behind. In these structures, which form the walls of the cavity, several apertures exist from the transmission of parts into and out of it. Superiorly, there are three in the diaphragm, for the aorta, œsophagus, and vena cava; inferiorly, there are two at each side, one for the femoral vessels, and one for the spermatic cord; in front there is one—the umbilicus, which, during fœtal life, transmits the umbilical arteries and vein. To these may be added the several interstices and apertures which give passage to the obturator, sciatic, pudic, and gluteal vessels.

Its contents.—The abdomen contains the greater part of the digestive organs, those for the secretion of urine, and part of those of generation. The first class includes the stomach and intestines, the spleen, the liver, and the pancreas, and the lacteal vessels, with their glands; the second comprises the kidneys and supra-renal capsules, with the ureters and bladder; and the third the spermatic vessels and ducts, with the vesiculæ seminales in the male, and the uterus, with the ovaries and Fallopian tubes, together with the vagina, in the female.

Division into regions.—The great cavity which extends, as above stated, from the diaphragm to the levatores ani, presents a sufficiently obvious division into two parts, the upper or larger one being the abdomen, properly so called, the lower the pelvis, the crista of the pubic bones and the ilio-pectineal line, which extends backwards to the promontory of the sacrum, marking the boundary between them. Again, the larger or upper compartment is subjected to what may be called a technical subdivision into regions; not that there are any septa or partitions between them, but because of the many and important parts which are contained in it, and which require to be minutely described. Pathologists have also found it necessary, in order to give precision to their inquiries, as well as clearness to the communication of the results of them to others, to adopt those subdivisions which anatomists had established for the purpose of facilitating their descriptions of parts.

With these views the cavity of the abdomen has been divided into three primary regions, a superior, an inferior, and a middle, which is intermediate between both. These may be marked out by two transverse lines, drawn round the body as follows: one (plate V. Nos. 1, 1), having commenced at the most prominent point of the cartilages of the ribs at one side, is drawn across to the corresponding point on the opposite, and so continued round the spine to the place at which it began, thus completing the circle. The other line (2, 2), proceeding from the crista of the ilium at one side, extends to that of the other, and so round the body, as in the former instance. The superior division, or zone, is called, from its position, the *epigastric region* (επι, above or upon; γαστηρ, the abdomen). Its lower boundary corresponds with the line above indicated, the upper with the ensiform cartilage and the diaphragm. The inferior division has been named the *hypogastric region* (ὑπο, under or beneath; γαστηρ, the abdomen), which extends from the lower transverse line to the crista of the os pubis, and to Poupart's ligament on each side. The intermediate, or middle division, is called the *umbilical region*, from the circumstance of the umbilical aperture being placed at its centre. These divisions not having been found sufficient for the purposes above stated, it became necessary to subdivide each of them into three minor regions, which may be done by drawing two lines (3, 3) parallel to one another, from

the cartilage of the eighth rib at each side down to the centre of Poupart's ligament. By this expedient each primary region is divided into a central and two lateral ones. The epigastric region is thus resolved to the two *hypochondriac regions* (HC: ὑπο, under; χονδρος, the cartilage), and the proper epigastric region (E), which is sometimes called "scrobiculus cordis." The middle zone is divided into the proper *umbilical* region in the centre (U), and the *lumbar* region at each side (L, L), and the inferior zone into the proper hypogastric or pubic region (HG) in the centre, and the *iliac* region at each side (I, I).

The mode of subdividing the primary regions here suggested, differs from that adopted by others. The vertical lines are usually directed to be drawn from the most prominent point of the costal cartilages to the anterior superior spinous process of the ilium. It must be obvious that the very purpose and intent of marking out these lines show that they are not confined to the surface on which they are drawn. They are, on the contrary, supposed to be projected into so many planes, forming partitions, which divide the cavity into compartments, each containing a certain portion of the abdominal viscera. Now, if lines were drawn from the costal cartilages to the spine of the ilium, they would exert no influence on the hypogastric region, inasmuch as they cease at its upper boundary; and in the next place, if projected backwards, they would leave the lateral parts of the umbilical region far too small. These reasons are obviously sufficient to warrant a departure from usage and precedent.

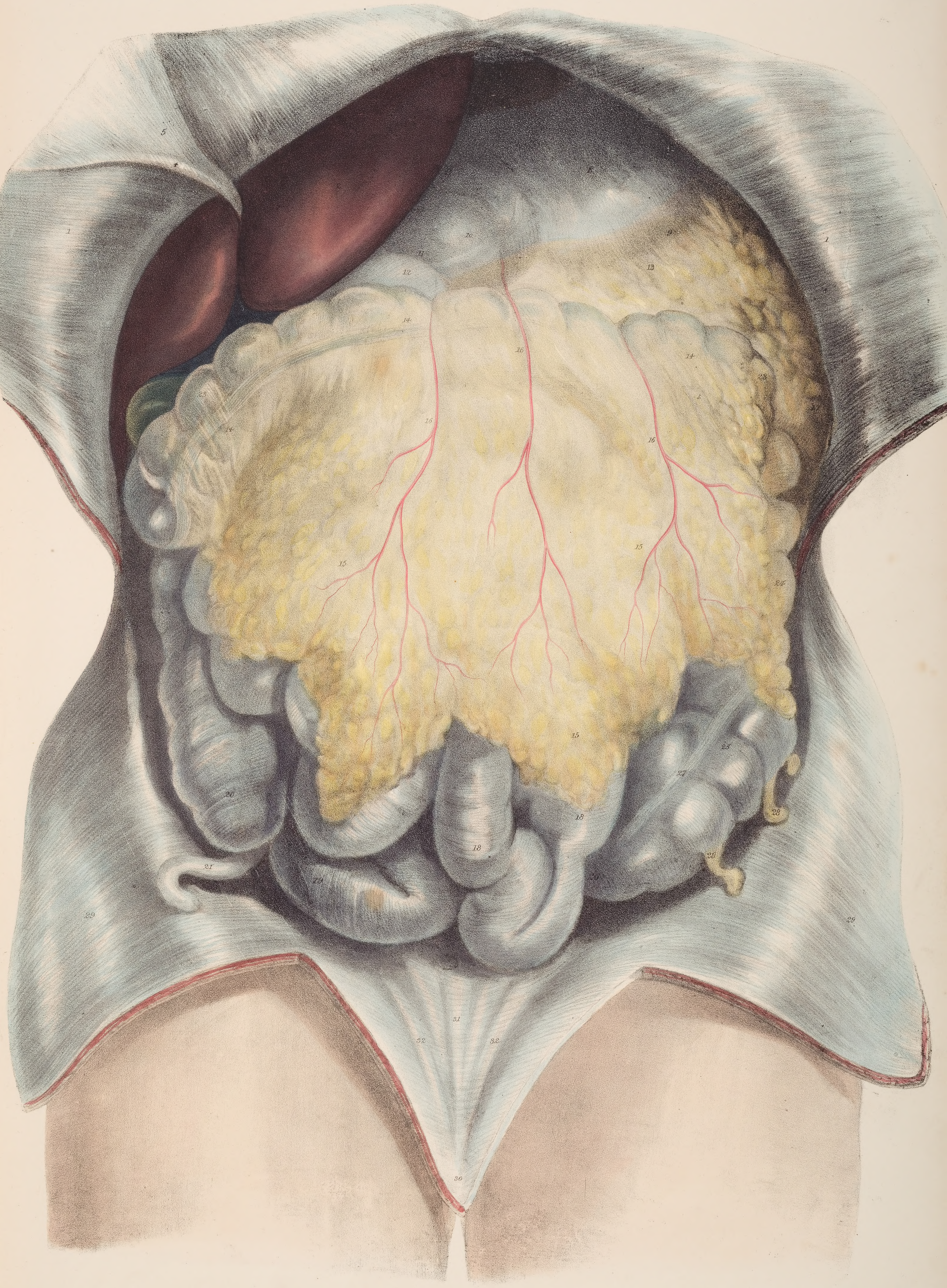
The epigastric region contains	The middle part of the stomach, with its pyloric extremity, the left lobe of the liver, the hepatic vessels, and lobulus Spigelii, the pancreas, the cœliac axis, the semilunar ganglia, part of the vena cava, also of the aorta, together with the vena azygos, and thoracic duct, as they lie between the crura of the diaphragm.
The left hypochondriac . . .	The large end of the stomach with the spleen and narrow extremity of the pancreas, part of the colon, the renal capsule, and upper part of the kidney.
Right hypochondriac . . .	The right lobe of the liver, with the gall-bladder, part of the duodenum and of the ascending colon, the renal capsule, and part of the kidney.
Umbilical	Part of the omentum and mesentery, the transverse part of the colon, transverse part of the duodenum, with some convolutions of the jejunum.
Right lumbar	Ascending colon, lower half of the kidney, and part of the jejunum.
Left lumbar	Similar parts at the opposite side.

PLATE VI.

The viscera of the abdomen in their natural position. This view is obtained by simply dividing the parietes by a crucial incision and turning aside the flaps.

Nos. 1, 1. The two superior flaps of the abdominal parietes turned over the border of the chest. The smooth and shining investment of peritoneum is well expressed in the drawing. 2. The liver,—its left lobe. 3. The cleft on the anterior margin of the liver. 4. The round ligament of the liver. 5. That part of the broad ligament which is attached to the abdominal parietes. 6. The right lobe of the liver. 7. The fundus of the gall-bladder projecting slightly beyond the margin of the right lobe. 8. The stomach. 9. The great curve of the stomach. 10. The lesser end of the stomach. 11. The pylorus. 12. The commencement of the duodenum. 13. The great omentum, given off from the great curve of the stomach. 14, 14. The two anterior layers of the great omentum passing in front of the transverse colon. 15, 15. The great omentum. 16, 16. Omental branches of the gastro-epiploic arteries, passing from the great curve of the stomach, and in front of the transverse colon. 17. The edge of the spleen partly concealed by the border of the great omentum. 18. The small intestines. 19. The ileum near its termination in the cæcum. 20. The cæcum. 21. The appendix vermiformis. 22. The ascending colon. 23, 23. The transverse colon, partly seen through the thin anterior layers of the great omentum. 24. The descending colon. 25. The sigmoid flexure. 26. The commencement of the rectum. 27. One of the longitudinal bands of the large intestine. 28, 28. Appendices epiploicæ. 29, 29. Lateral flaps of the abdominal parietes, displaying the bright and polished surface of the peritoneum. 30. An anterior and inferior flap, upon which are seen some slightly elevated ridges formed by fibrous cords situated beneath the peritoneum. 31. The elevation formed by the fibrous and cord-like remains of the urachus. 32, 32. The ridges formed by the fibrous cords of the umbilical arteries, the umbilical ligaments.

Plate 6.



W.J.E. Wilson direxit.

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Plate 7.

Fig. 1.

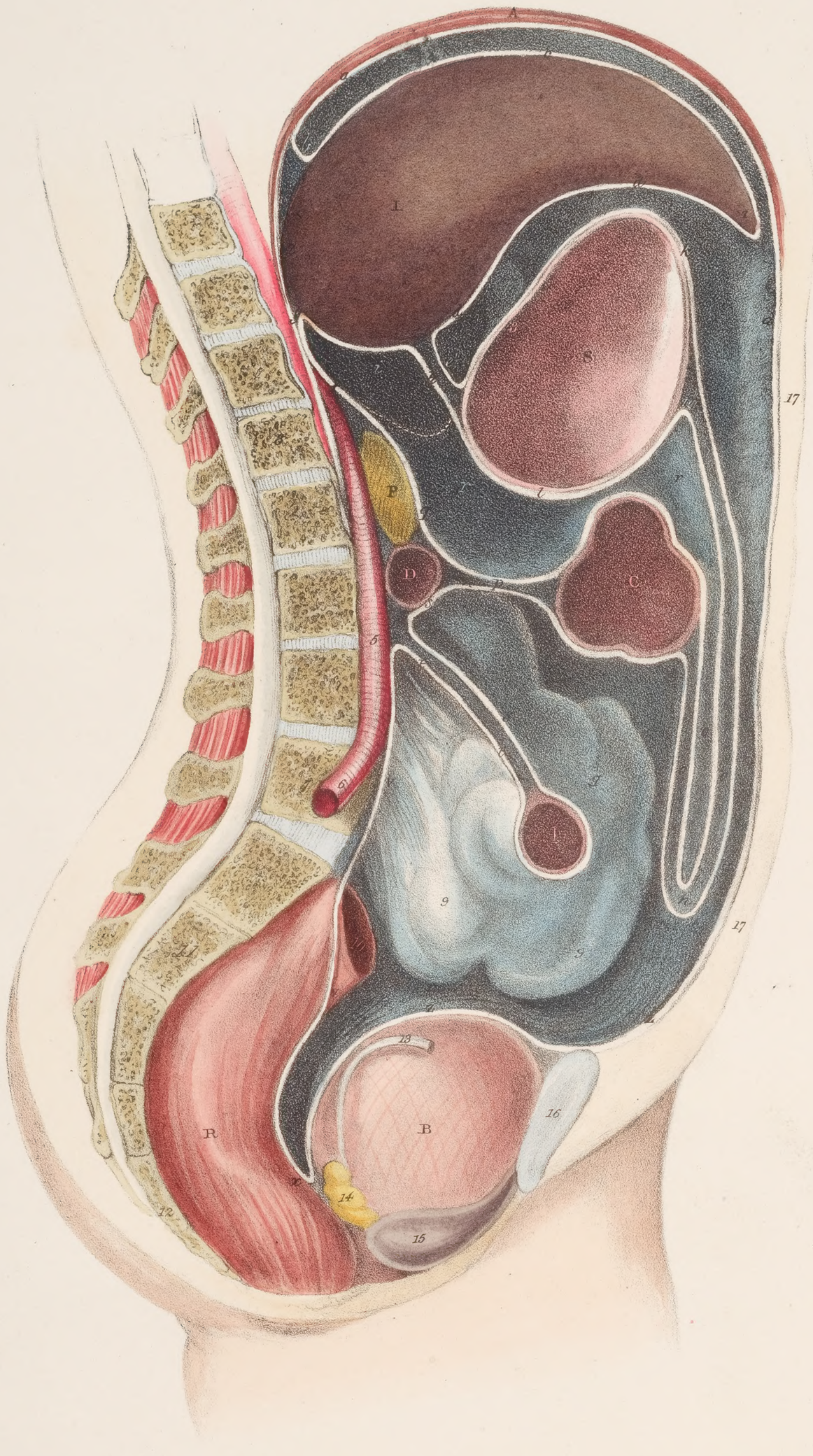

Fig. 2.

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Hypogastric region	The convolutions of the ileum, the bladder in children, and in adults if distended, the uterus under like circumstances.
Right iliac fossa	The cæcum, ilio-cæcal valve, the ureter and spermatic vessels.
Left iliac fossa	Sigmoid flexure of the colon, the ureter, and spermatic vessels.

As it is the usual practice to examine the serous membrane which invests the different organs here enumerated, and also lines the abdomen, we shall describe it in this place.

The *Peritonæum: its general conformation.*—The name applied to this membrane has been taken from its relation to the abdominal viscera (*περιτεινω, to extend around*). It is the most extensive serous sac in the body, as it not only lines the parietes of the abdomen, but is also reflected over each of the organs it contains, at the same time that it forms several folds of considerable extent.

Preparation.—After the abdominal muscles have been dissected, the transversalis muscle should be carefully separated from the peritonæum, and removed altogether from it, commencing over the

PLATE VII.

Sections of the abdomen, showing the reflections of its serous membrane, the peritonæum.

Fig. 1. A vertical section of the abdominal cavity.

A. The diaphragm. L. The liver. 1. The free margin of the liver. 2. The posterior or rounded border of the liver, which lies in contact with the diaphragm. S. The stomach. 3. Its cardiac orifice. 4. The œsophagus seen indistinctly as it passes through the diaphragm. C. The transverse colon divided transversely. D. The transverse portion of the duodenum. P. The pancreas. 5. The abdominal aorta. 6. The right common iliac artery. 7. The fifth lumbar vertebra. 8. The first lumbar vertebra. I. The tube of the small intestine divided transversely. 9, 9. The mass of the small intestines enclosed by peritonœum. 10. The divided cylinder of the rectum. R. The rectum. 11. The sacrum. 12. The coccyx. B. The urinary bladder. 13. The ureter of the right side. 14. The vesicula seminalis of the same side. 15. The prostate gland enclosed by the pelvic fascia. 16. The symphysis pubis. 17, 17. The abdominal parietes.

a, a. An anterior layer of the peritonæum, which lines the abdominal parietes and the under surface of the diaphragm. b. The reflection of this layer from the diaphragm to the convex surface of the liver. c. The same layer investing the convex surface of the liver. d. Its reflection upon the concave surface of this organ. e. Its reflection from the under or concave surface of the liver to the lesser curvature of the stomach. f. A posterior layer of the peritonæum lining the posterior wall of the cavity of the abdomen. g. Its point of reflection upon the posterior and rounded border of the liver. The layers b and g constitute the coronary ligament of the liver. h. The reflection of the posterior layer from the liver to the lesser curvature of the stomach. The two layers e and h constitute the lesser omentum. i. The situation of the foramen of Winslow, marked inferiorly by a dotted line. k. The anterior layer of peritonæum, passing in front of the stomach. l. The posterior layer, passing behind the stomach. m. The approximation of the two layers at the greater curvature of the stomach. n. The reflection of these two layers upwards to the colon. The four layers formed by this reflection constitute, o, o, the great omentum. p. The two ascending layers continued backwards towards the vertebral column, after having surrounded the transverse colon: they constitute the transverse meso-colon. q. The superior layer of the transverse meso-colon continued upwards in front of the pancreas, and shown to be continuous with the posterior layer, f. The cavity, r, r, has been very inappropriately named the lesser cavity of the peritonæum: it communicates with the general cavity through the foramen of Winslow. s, s. The inferior layer of the transverse meso-colon reflected downwards upon the small intestines, and returning upon itself, t, t, forms the duplicature, s, t, the mesentery, which retains the small intestines in connexion with the posterior wall of the abdomen. v, v. The inferior layer of the mesentery continued downwards over the rectum, and reflected at x upon the posterior surface of the urinary bladder. The duplicature at x is the recto-vesical fold of peritonæum. The layer is then traced upwards, z, z, upon the anterior wall of the abdomen, and shown to be continuous with the anterior layer, a, a.

Fig. 2. A transverse section of the cavity of the abdomen, showing the reflections of the peritonæum.

Nos. 1, 1. The integument surrounding the abdomen. 2, 2. The rectus muscle enclosed in its sheath. 3. The linea alba. 4, 4. The linea semilunaris at each side. 5, 5. The three planes of abdominal muscles,—obliquus externus, obliquus internus, and transversalis. 6, 6. The erector spinæ. 7, 7. The quadratus lumborum enclosed in its sheath. 8, 8. The psoas muscle on each side. 9. The upper surface of a lumbar vertebra. 10. The divided cauda equina. 11. The aorta. 12. The inferior vena cava. I. The ileum near to its termination. 13. The termination of the ileum in the colon is dimly seen in the lower part of the cavity. 14. The cæcum. 15. The appendix vermiformis. 16. The ascending colon. A, C. Section of the ascending colon. D, C. Section of the descending colon. 17. Sigmoid flexure. 18. The convex outline of the urinary bladder.

a, a. The peritonæum traced from the linea alba upon the inner surface of the abdominal parietes to its reflection around the ascending colon. b. The ascending meso-colon. c. The layer continued onwards over the psoas muscle and inferior vena cava, and reflected forwards at d, so as to encircle the small intestine. e. The peritonæal layer returning towards the vertebral column. These two layers, d and e together, constitute the mesentery. f. The returning layer, continued into the left lumbar region, surrounds the descending colon, and returning upon itself, g, is thence traced upwards, h, h, to the linea alba, where it is seen to be continuous with a, a. The duplicature, i, is the descending meso-colon.

iliac region, and so proceeding up to the costal cartilages, and backwards, deeply into the lumbar region. The same should be done at the opposite side; but, along the middle line, part of the aponeurosis must be allowed to remain, in consequence of its firm adhesion to the membrane. This at once gives a general view of the membrane: it appears like a loose bag placed within the walls of the abdomen, forming a lining for them. The more usual mode however is, after dissecting the muscles, to divide whatever remains of the parietes by a perpendicular and transverse incision, and reflect the flaps thus formed.

The student will find his progress facilitated if he will first make himself familiar with the names, position, and extent of the different folds of the membrane which have received names, and then proceed to trace their connexion and continuity as parts of a whole.

The drawing (plate VII. fig. 1) will serve for both purposes; it is a diagram which represents the parts as they would be seen if a vertical section were made through the abdomen and its contents, so that they may be seen in a side view. L, is the liver; S, the stomach; C, the transverse colon; D, the transverse part of the duodenum; P, the pancreas; I, the small intestines; B, the bladder; R, the rectum; o, o, n, mark the great omentum; e, h, the small omentum; s, t, the mesentery; p, the transverse meso-colon.

The folds or duplicatures, above alluded to, are as follows:

The *Great Omentum* (plate VI. Nos. 15, 15; plate VII. fig. 1, o, o: epiploon majus; epiploon gastro-colicum; επιπλεω, to float upon,) is the broad floating process of peritonæum which lies loosely over the fore part of the small intestines. Its upper extremity is attached to the great curvature of the stomach, to the left of which it is continuous with the gastro-splenic omentum; at the right side it extends as far as the duodenum; it is intimately connected with the transverse colon, below which it floats loosely over the small intestines. It consists, at the lower part, that is to say, below the transverse colon, of four lamellæ.

The *Small Omentum* (plate VII. fig. 1, e, h: o. minus; epiploon gastro-hepaticum) extends from the transverse fissure of the liver to the concave border of the stomach, enclosing the hepatic vessels. At its right margin, the membrane is folded so that both layers are continuous, whilst the left extends over to the œsophagus. Behind this is a canal, i, which leads down behind the stomach into the bag of the great omentum. Through this, which is called *foramen Winslowi*, the great cavity of the peritonæum becomes continuous with that enclosed within the layers of the great omentum.

The *Mesentery* (plate VII. fig. 1, s, t: mesenterium, μεσος, εντερον, intestine,) is the large duplicature which corresponds by its greater circumference with the whole length of the jejunum and ileum, to which it is conducted by the mesenteric vessels, which it encloses, together with the lacteal absorbents and their glands, whilst its base or point of reflection extends obliquely across the spine from the left side of the second lumbar vertebra down to the right sacro-iliac symphysis. Its upper and left border is continuous with the transverse meso-colon, whilst at the lower and right side it gradually spreads into the ascending meso-colon.

Meso-cola.—The lateral parts of the colon are bound down by duplicatures, which are named from their position *meso-colon ascendens, et descendens* (plate VII. fig. 2, b, i). The transverse portion of that intestine is connected with a broader one (plate VII. fig. 1, p; *meso-colon transversum*), continuous with the posterior layers of the great omentum; for these, after enclosing the transverse colon, are continued backwards to the spine, at the same time diverging so as to leave an angular interval, across which runs the terminal or third portion of the duodenum.

Meso-rectum.—This is a narrow fold which connects the back part of the rectum with the sacrum.

Appendices Epiploicæ.—Along the great intestine some processes (plate VI. Nos. 28, 28) are attached, varying in form and size, some fringed, others pediculated. They are diverticula or sacculi formed by the peritonæal coat of the gut, filled with adeps.

We find the following duplicatures connected with the liver (plate X). It may be here observed that these as well as other folds which are situated in the pelvis, are called "ligaments," from their effect in retaining the organs in their situations. There are four folds of this sort attached to the liver; one upon its upper surface, connecting it with the diaphragm, from which circumstance it is called its "suspensory ligament" (*ligamentum suspensorium*), but from its shape it is named "falciform process," or falx. It indicates the line of division between the left and right lobes of the liver; its lower border or base encloses the umbilical vein or the ligament into which it is converted. The folds which connect the lateral lobes of the liver at each side to the diaphragm, are called "lateral or triangular ligaments" (*ligamentum laterale dextrum, et sinistrum*); between these lies another to-

wards the middle line, the "coronary ligament" (*ligamentum coronarium*, plate VII. fig. 1, b, g; plate X).

In the pelvis there are some folds connected with the bladder, the rectum, and the uterus, which deserve notice.

From the summit of the bladder three long but very narrow folds extend upwards to the umbilicus (plate VI. Nos. 31, 32); one in the middle line, corresponding with the urachus, and one on each side with the umbilical arteries. Where the peritonæum is reflected from the base of the bladder backwards upon the rectum, it presents two lunated folds usually called the "posterior ligaments" of the bladder.

From the sides of the uterus two broad folds of peritonæum extend outwards to the wall of the pelvis, with which they connect it; hence they are called the "broad ligaments" of the uterus. They enclose the uterine vessels, the round ligaments, the ovaria and the Fallopian tubes.

The student may now proceed to note the way in which the peritonæum is reflected from one organ to another, and how it is thrown into the folds here indicated. Begin at the small omentum (plate VII. fig. 1, e, h), as a starting point: you find it to consist of two layers; take the upper one, e, trace it to the small curvature of the stomach, S, and then over its anterior surface, k, as far as the great curvature, m; from this it reaches down, forming the upper layer of the great omentum, o, o, at whose lower border, n, it becomes reflected, and returns up as far as the transverse colon, C; having invested the under surface of this part of the intestine, it passes backward, forming the under layer of the transverse meso-colon, p, and then beneath the transverse part of the duodenum, D; at this point it is again prolonged forwards to the small intestine, I, and returns after investing it, thus forming the upper and under layers of the mesentery, s, t. From the mesentery it reaches down in front of the spine at v, and then upon the rectum, R, and the bladder, B, forming a fold at the point of reflection, x, from one to the other. From the summit of the bladder it is prolonged to the parietes of the abdomen at z, and so upwards as far as the costal cartilages at a, where it comes into contact with the diaphragm, D, whose under surface it lines. From this it is reflected upon the liver at b, forming the upper layer of its coronary and lateral ligaments. It invests the upper and under surface of the liver, L, as far as the transverse fissure, where it is reflected down upon the portal vessels, forming the upper or anterior layer of the small omentum, to the point at which we commenced to trace its reflections and relations to the viscera. Now, beginning again at the small omentum, and taking its under layer, h, you trace it to the small curvature of the stomach, and thence along the under surface of this organ, l, as far as its great curvature, m; from this point the membrane reaches down, forming the inner layer of the great omentum, o, o, at whose lower border it is reflected up to the transverse colon, C; after investing the upper surface of this part of the intestine, it is reflected back towards the spine, forming the upper layer of the transverse meso-colon, p; it is thence prolonged at q, successively in front of the transverse part of the duodenum, D, the pancreas, P, and the crura of the diaphragm: from the diaphragm it is reflected to the liver at g, where it forms the under layer of its coronary and lateral ligaments: it invests the surface of the liver as far as the transverse fissure, where it is reflected down, forming the under layer of the small omentum, whence we set out in tracing its reflections.

It may here be observed, that it is difficult at first sight to conceive how the different vessels can reach the viscera without piercing the peritonæum, inasmuch as the trunks from which they proceed lie behind it. The aorta lies on the spine, behind the peritonæum; the kidneys, placed at the sides, are also behind that membrane; there can, therefore, be no difficulty in perceiving how their vessels reach them. The mesentery, consisting of two lamellæ, is reflected from the spine close to the origin of the superior mesenteric artery, which is thus placed between its layers. The inferior mesenteric artery, after running behind the peritonæum to the pelvis, lies between the sacrum and rectum, in the fold of the meso-rectum: the colic vessels are enclosed in the meso-cola. It remains for us first to consider how the cœliac axis and its vessels lie with regard to the membrane; which can only be done with effect by examining the formation of what is called Winslow's foramen, which, properly speaking, is a canal or tube, not a perforation, as the term foramen would imply. If the finger be passed close by the neck of the gall-bladder, beneath the free border of the small omentum, the two lamellæ of the omentum, with the hepatic vessels enclosed, will lie upon the finger, and the ascending layer of the transverse meso-colon behind it. If an effort be made to pass the finger down behind the stomach, it is at once checked by the manner in which the membrane is there reflected backwards and upwards. Just below the point of reflection stands the cœliac axis, so that its hepatic and coronary branches, by passing over this reflected part, can get between the layers of the small omentum,

and thus reach their destinations. Now, the splenic artery runs along the pancreas, which has been shown to be posterior to the ascending layer of the transverse meso-colon, but on reaching the spleen it insinuates itself between the layers of its epiploon (gastro-splenicum).

The Stomach.—The stomach (plate IV. A; plate VI. No. 8; plate VIII. fig. 1; plate IX. fig. 1: γαστηρ, ventriculus) is a hollow, musculo-membranous viscus, occupying part of the left hypochondriac and epigastric regions. It is the largest or most distended part of the alimentary canal, being continuous, by one extremity, with the œsophagus (plate IV. 1), which opens into it from above, and by the other with the duodenum, (7,) which forms the first part of the intestines properly so called. Its form is somewhat conical, being also curved, so as to incline downwards and forwards; but its form and direction vary remarkably in different ages of life: in the fœtus it does not extend so transversely from left to right as is the case in the adult; the pylorus is, on the contrary, placed with rather a slight obliquity beneath the cardia, the line of its axis being from above downwards.

The stomach is in intimate relation with many important organs; it lies beneath the diaphragm and liver, above the transverse colon, having the spleen on its left, and the duodenum on its right, whilst its anterior surface is in contact with the wall of the abdomen, and the posterior rests on the pancreas and great vessels,—the ascending layer of the transverse meso-colon interposing. It is usual to consider successively its surfaces, borders, and extremities. When empty, one surface looks forwards, and the other backwards; but when distended its body changes its position, so that the former inclines somewhat upwards, the latter obliquely downwards, by which means the great curvature comes towards the anterior parietes of the abdomen, whilst the smaller looks towards the spine and

PLATE VIII.

Disposition and structure of the mucous membrane of the alimentary canal.

Fig. 1. A longitudinal section of the stomach and duodenum, showing their internal surface, with the arrangement of the mucous membrane.

No. 1. The lower part of the œsophagus. 2. The cardiac orifice of the stomach. 3, 3. The abrupt border formed by the termination of the cuticular epithelium of the œsophagus at the cardiac opening of the stomach. 4, 4. The rugæ of the mucous membrane. 5. The great end of the stomach, in which the rugæ of the mucous membrane are less marked than in the middle of the organ. 6. The lesser curve of the stomach. 7, 7. The greater curve. 8. The pylorus. 9, 9. Two segments of a spiral fold of mucous membrane situated in the pyloric opening. 10. The ascending portion of the duodenum. 11. The descending portion of the duodenum. 12. The transverse portion of the duodenum. 13. The commencement of the jejunum. 14, 14. The first valvulæ conniventes, which are of small size. 15, 15. Larger valvulæ conniventes. 16. The papilla upon which the ductus communis choledochus and pancreatic duct terminate. 17. A part of the ductus communis choledochus. 18. The pancreatic duct near to its termination.

Fig. 2. A section of the cæcum and part of the colon, with the lower termination of the ileum, showing the ileo-cæcal valve.

No. 1. The ileum near to its termination. 2. The cul-de-sac of the cæcum. 3, 3. The appendix vermiformis. 4. The entrance of the appendix vermiformis. 5, 5. The two semilunar segments forming the ileo-cæcal valve. 6. The opening of the ileum into the cæcum. 7. The colon. 8, 8. Valvular projections of the mucous membrane forming the boundaries of the sacculi of the large intestine. 9, 9. The surface of the mucous membrane raised into minute folds.

Fig. 3. A section of the cæcum through the ileo-cæcal valve.

No. 1. The ileum. 2. The cæcum. 3. The appendix vermiformis. 4. A small mesentery attached to the appendix vermiformis, and producing its curve. 5, 5. The two segments of the ileo-cæcal valve, each formed by three layers, the middle dark layer representing an extension of the muscular coat. 6. The colon. 7, 7. The folds which form the boundaries of the sacculi of the large intestine.

Fig. 4. Scales of epithelium from the surface of the mucous membrane of the mouth, each presenting a central nucleus.

Fig. 5. Cylinders of epithelium from the mucous membrane of the cardiac extremity of the stomach.—From Henle's "Symbolæ ad anatomiam villorum intestinalium, imprimis eorum epithelii et vasorum lacteorum."

Fig. 6. Cylinders of epithelium from the jejunum.—After Henle.

a. The central nucleus. b. The small end, which is in contact with the mucous membrane. c. The broad end or free extremity of the cylinder. d. A cylinder placed obliquely in order to show the surface of the free extremity.

Fig. 7. A group of cylinders of epithelium from the small intestine, agglutinated together, and seen by their free extremities. The nuclei are slightly seen through the centre of the broad end of each cylinder.—After Henle.

Fig. 8. An ideal diagram of a single villus of the small intestine covered with columnar cylinders of epithelium. Fig. 7 represents a small group of these cylinders more highly magnified.—After Henle.

Fig. 9. A transverse section of a circular villus, showing the radiated and columnar disposition of the cylinders of epithelium.—After Henle.

Plate 8.

Fig. 1.

Fig. 7.

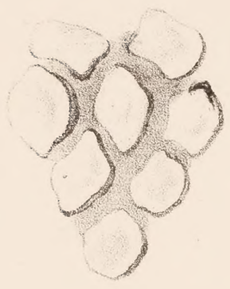

Fig. 5.

Fig. 6.

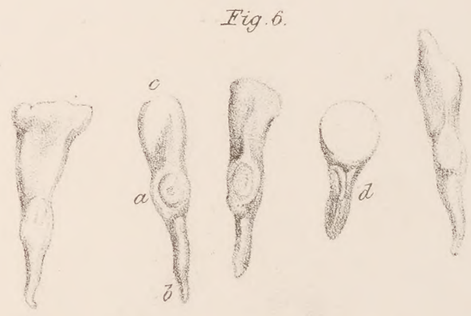

Fig. 8.

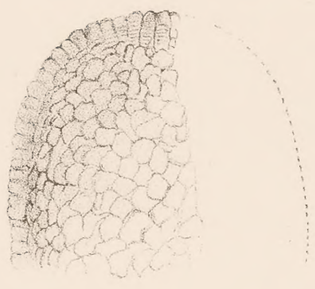

Fig. 9.

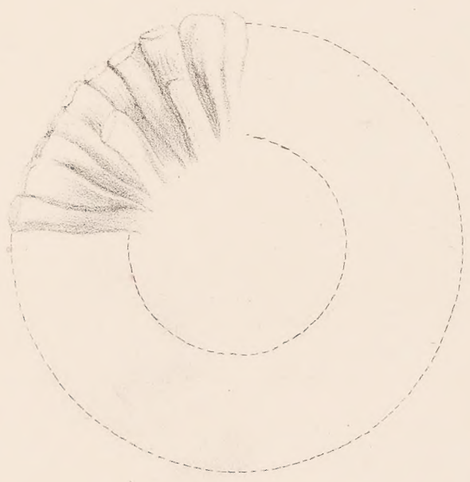

Fig. 3.

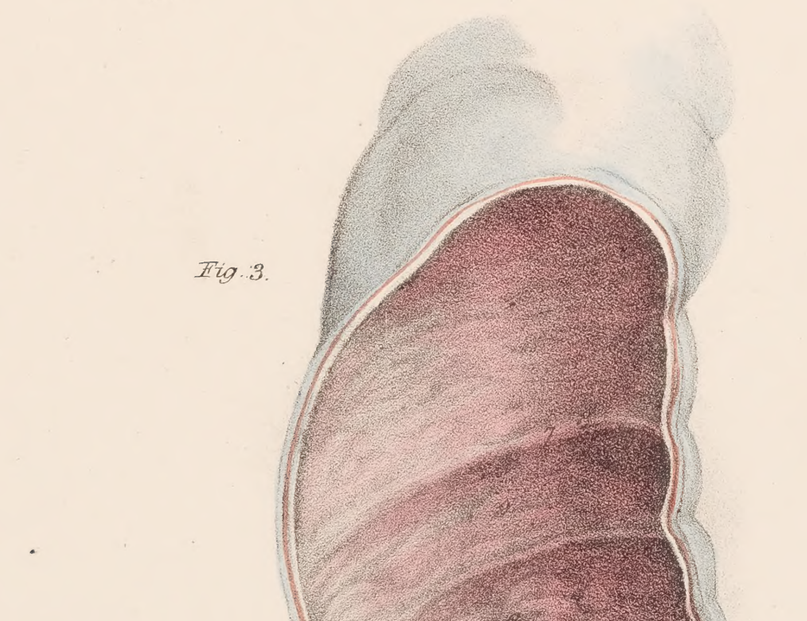

Fig. 4.

Fig. 2.

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Plate 9.

Fig. II.

Fig. 1.

Fig. 12.

Fig. 3.

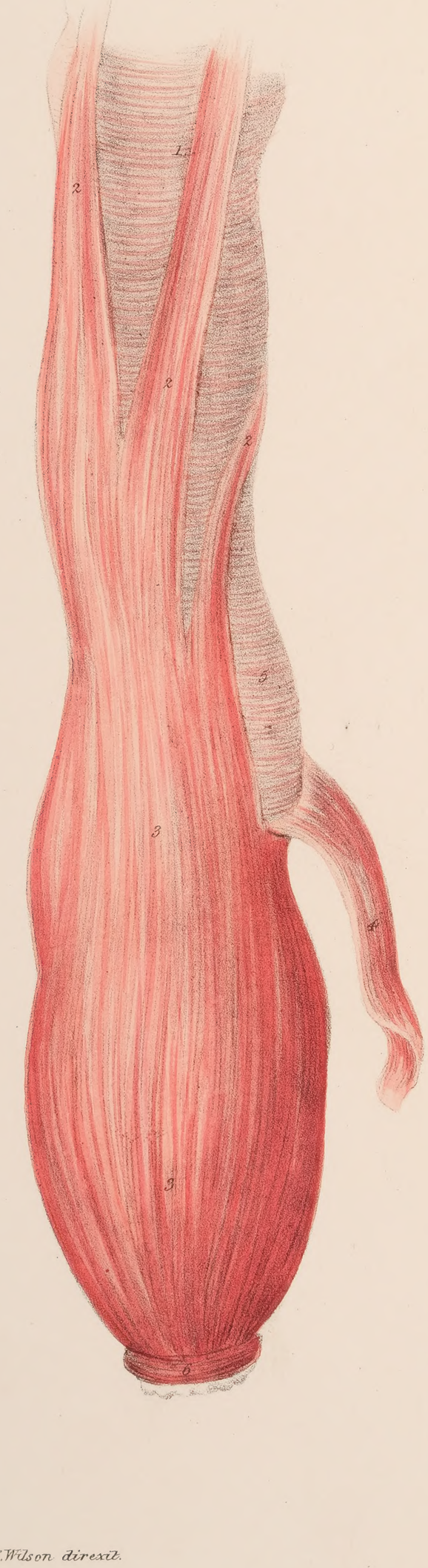


Fig. 10.

Fig. 4.

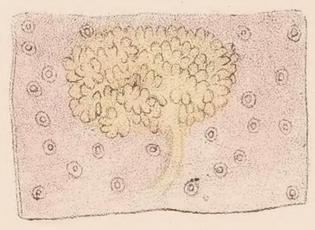


Fig. 9.

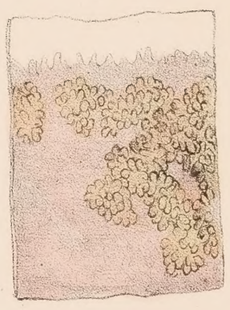
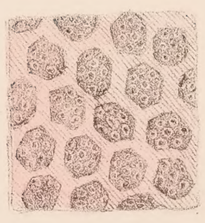


Fig. 5.



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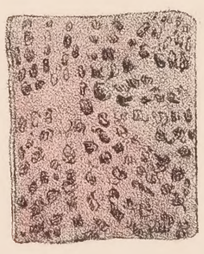

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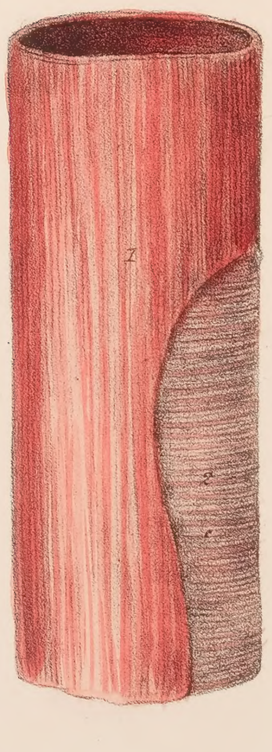

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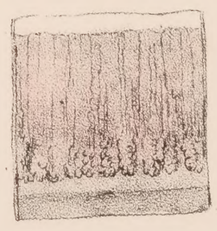

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large vessels. The lower border of the stomach is of considerable extent, and is named its *great curvature* (plate IV. No. 6); along it run the gastro-epiploic vessels; opposite the spleen it expands very much, bulging out into a sort of diverticulum, which is called the *great cul-de-sac* of the stomach, and sometimes its left or *splenic* extremity (2). A fold of peritonæum (*splenic omentum*) connects this part of the stomach to the spleen; the rest of the curvature gives attachment to the great omentum.

The upper border is concave, and forms the *small curvature* (5), which extends from the œsophagus to the pylorus, being not more than three inches in length; it is connected by the small omentum to the inferior surface of the liver, the vascular arch formed by the coronary and pyloric arteries being parallel with it.

The *left* or *splenic* extremity of the stomach comprises the expanded or dilated part above noticed; at its upper part, where it touches the diaphragm, it becomes, as it were, constricted rather abruptly, and unites with the termination of the œsophagus, which here opens into it. The junction here indicated takes place in such a way, that two-thirds of the length of the stomach appear to its right, and one-third to the left. This narrowed part corresponds with the upper aperture or inlet of the stomach, and is called *cardia*, or the *cardiac* orifice (plate VIII. fig. 1, No. 2). The *right*, or *pyloric* extremity of the stomach (plate IV. No. 3) is elongated so as to represent the summit of a cone, to which this organ has been likened; it commences at a slight angular turn, marked by a crease or fold, where the great curve of the stomach ends at the right side, from which it ascends towards the under surface of the liver, at the same time inclining backwards, and ends at a circular constricted line (4),

PLATE IX.

The muscular coat of the alimentary canal, with the structure of the mucous membrane.

Fig. 1. The muscular coat of the stomach.

No. 1. The œsophagus, upon which are seen the longitudinal fibres. 2, 2. The peritonæal coat turned back from the surface of the stomach. 3. The longitudinal fibres of the stomach, most apparent along its lesser curve. 4, 4. The circular fibres, most developed towards the lesser end. 5. The annular aggregation of the circular fibres forming the constriction of the pylorus. 6, 6. The oblique fibres at the great end of the stomach. 7. The commencement of the duodenum.

Fig. 2. A portion of small intestine from which the serous coat has been stripped off.

No. 1. The longitudinal fibres. A portion of the longitudinal fibres has been removed in order to bring into view the deeper layer, which is composed of circular fibres.

Fig. 3. The rectum.

No. 1. The termination of the colon. 2, 2, 2. The three longitudinal bands of muscular fibres. 3, 3. The longitudinal muscular fibres of the rectum. 4. A portion of the layer of longitudinal fibres, turned down in order to show the circular fibres, 5. 6. The internal sphincter.

Fig. 4. A small portion of the mucous membrane of the œsophagus near its lower extremity, exhibiting an arborescent conglomerate gland (œsophageal gland) opening upon the surface by a somewhat lengthened oblique duct. The small circles scattered over the surface are the openings of mucous follicles. This preparation is magnified fifteen times.—From Dr. T. L. W. Bischoff's paper, "Ueber den Bau der Magenschleimhaut," in Müller's Archiv. for 1838.

Fig. 5. Cells of the human stomach; open mouths of tubes seen at the bottom of each: magnified thirty-two diameters.—From Dr. Sprott Boyd's "Essay on the Structure of the Mucous Membrane of the Stomach," in the Edinburgh Medical and Surgical Journal for 1836, vol. xlvi.

Fig. 6. The inner surface of the stomach of a woman, magnified twenty-five times. The openings of the gastric follicles are disposed in groups.—From Dr. T. L. W. Bischoff's paper.

Fig. 7. A perpendicular section of the mucous membrane of the stomach from the cardiac extremity. The gastric follicles are seen to terminate in simple cæcal extremities; they are filled with a granular-looking secretion.—From Dr. T. L. W. Bischoff's paper.

Fig. 8. A perpendicular section of the mucous membrane of the stomach from the pyloric extremity; the cæcal terminations of the gastric follicles are clustered.—From Dr. T. L. W. Bischoff's paper.

Fig. 9. A portion of the mucous membrane of the duodenum, seen upon its under surface, and showing the duodenal or Brunner's glands. This preparation is magnified fifteen times.—From Dr. T. L. W. Bischoff's paper.

Fig. 10. A small portion of the mucous surface of the lower extremity of the ileum, showing a cluster of Peyer's glands, natural size. The villi are seen upon one side of the preparation.

No. 1. A solitary gland forming a projection of the mucous membrane.

Fig. 11. A small portion of one extremity of a cluster of Peyer's glands highly magnified. The white patches of the glands are each surrounded by a zone of openings resembling those of the follicles of Lieberkuhn, which are seen to be scattered irregularly between the villi in the upper part of the figure. A number of conical villi are also seen.—From Müller's Physiology, translated by Dr. Baly: after the illustrations to Dr. Boehm's paper "De Glandulorum Intestinalium Structurâ Penitiori." Berlin, 1835.

Fig. 12. a. A solitary gland from the large intestine, somewhat enlarged, and delineated from nature. b. A section of one of these follicles.—After Dr. Boehm.

which can readily be perceived at the exterior, and which, when compressed between the fingers, gives the sensation as if a cord-like ring surrounded the interior of the tube. The point here indicated corresponds with the inferior opening of the stomach, by which it communicates with the duodenum; it is called the *pyloric* aperture, for it is surrounded by a ring of muscular fibres above alluded to, and which is termed *pylorus* (πυλη, a gate; ουρος, a guardian), from some resemblance to a sphincter muscle. When examined, it will be found so placed, that, whilst its circumference is identified with the wall of the stomach, its free border projects towards the central line of the canal, as if for the purpose of retaining the food until it is digested.

Structure.—The stomach is composed of three coats, connected together by two lamellæ of cellular tissue, which were formerly enumerated also,—particularly the one between the middle and inner coats,—and which was called the nervous tunic, from being supposed to consist of the ultimate ramification of the nerves. The external, or *serous* coat (plate IX. fig. 1, Nos. 2, 2), is derived from the peritonæum, and forms but a partial investment for this, as for other organs, inasmuch as, by being reflected away at its curvatures, it leaves two linear intervals there uncovered. The second, or *muscular* coat (fig. 1), consists of thin and pale fibres, placed on different planes, and pursuing different directions. The fibres subjacent to the serous membrane are disposed longitudinally (3), being continuous with those of the œsophagus, from which they spread out, as they proceed from the cardiac towards the pyloric orifice; the second layer of fibres is circular (4, 4); but though no individual fibre can be found to extend farther than from a third to a half of the circumference of the viscus, yet they can sometimes constrict it towards the centre, so as to give it a sort of hour-glass contraction.* The fibres of the third order (6, 6) are scattered and irregular; being found only towards the splenic end of the stomach, where they in a manner decussate with the circular fibres, which in that part are rather few in number. The internal coat, called *mucous*, (plate VIII.) from its peculiar secretion, and *villous*, from the numerous delicate papillæ, like the pile of velvet, that project upon it, forms part of the lining membrane of the alimentary canal. It has been already described in the section on the general anatomy of mucous membranes (page 4 et seq.).

Vessels and nerves.—The stomach derives its blood from two arterial arches, which correspond with its two curvatures; the upper one being formed by the coronary artery and the pyloric branch of the hepatic, the lower by the two gastro-epiploic branches; one being derived from the hepatic, the other from the splenic artery. Besides these, its splenic end receives the vasa brevia from the splenic artery. Its residual blood is conveyed by corresponding veins into the splenic vein; whilst its nerves consist of the terminal branches of the two vagus nerves, and of the stomachic plexus, which is derived from the great solar plexus.

The Intestinal Canal.—The intestinal canal (plate IV.) extends from the pylorus to the anus, and in the human subject varies in different individuals; hence it has been variously stated as being from fifteen to twenty-seven feet by Meckel, and from ten to twenty-five by Cruveilhier. It is coiled on itself, so as to form folds or convolutions, and presents two parts, differing in size and situation, as well as in external conformation. Moreover, the division between them is marked by a peculiar valvular structure, which prevents a reflux of the ingesta after they have passed beyond it. The part of the canal between the pylorus and the valve just referred to is called the small intestine (*intestinum tenue;* B, C); the remainder thence onward to the anus, the large intestine (*intestinum crassum;* D to I). Anatomists have agreed to consider the small intestines as divisible into three parts, viz. the *duodenum*, *jejunum*, and *ileum;* premising, however, that they are but portions of a continuous tube, the lines of division between them being altogether arbitrary.

Duodenum.—The duodenum (plate IV. B; plate VIII. fig. 1, Nos. 10, 11, 12) has been so called from being in its length equal to about twelve fingers' breadth. Its diameter is greater than that of the jejunum or ileum; it is also more distensible. In its course it will be observed to curve on itself, so as to describe a considerable portion of a circle; for, having commenced at the pylorus, it ends at the left side of the second lumbar vertebra, and is divisible into three portions, each presenting some circumstances deserving of notice. The first, which is the shortest, being about two inches in length, ascends a little, at the same time inclining backwards and to the right side so as to touch the gall-bladder: hence, soon after death, it becomes tinged yellow by the bile. Opposite the neck of the gall-bladder the intestine turns on itself, and descends perpendicularly in front of the right kidney as far as the third lumbar vertebra, where it again alters its direction, passing across the spine, ascending a little, so as to end at the left side of the second lumbar vertebra, where it is continuous with the jejunum. The concavity of the curve formed by the duodenum is turned to the left side, so as

* Sir E. Home, Phil. Trans.—Wilson, Philip, On the Vital Functions.

to enclose within it the head of the pancreas. Its transverse part is crossed by the mesenteric vessels, which necessarily separate it from the lower border of the pancreas. The ascending portion is not only shorter than the others, but is also of smaller diameter; it is covered in the greater part of its extent by peritonæum. The descending part is covered by it only on its anterior surface, whilst the transverse part has no immediate serous investment, as it merely lies in the divergence of the two layers of the transverse meso-colon. Its muscular coat is thick, the circular fibres being more strongly marked than the longitudinal. The internal surface presents a great number of transverse folds, called *valvulæ conniventes*. At the angle of union formed by the descending and transverse parts of the intestine, will be observed a small papilla, marking the orifice of the biliary and pancreatic ducts, which open at that point.

Jejunum and Ileum.—The jejunum and ileum (plate IV. C, C) are so called, the former from being usually found empty after death, the latter from its position in the fossæ of that name. They occupy the interval from the duodenum to the ilio-colic valve, two-fifths of the whole length being assigned to the jejunum (17, 17), and three-fifths to the ileum (18, 18). The diameter of the tube diminishes gradually as it approaches the latter point. This part of the intestinal canal presents numerous coils or convolutions, which, taken together, are found in the umbilical region, at the same time extending laterally into the lumbar regions, and downwards into the hypogastric and iliac. Thus situated, the small intestine is in a manner enclosed within the curve formed by the colon. The outer surface is smooth, and free in its entire extent, except along its posterior border, where it is connected with the mesentery.

Structure.—The coats of the jejunum are thicker than those of the ileum, but they are similar in every other respect; the serous coat is derived from the mesentery, to the circumference of which these portions of the canal are attached; and the muscular coat presents some longitudinal and superficial fibres, the rest forming arches of circles, but not extending round the tube. The valvulæ conniventes, which are numerous at the commencement of the jejunum, diminish in number and size gradually towards the ileum, and cease in the lower part of the latter.

Vessels and nerves.—The duodenum receives its arteries from the pancreatico-duodenalis, from the pyloric and superior mesenteric arteries; its veins open into the coronary and superior mesenteric; its nerves are offsets from the mesenteric and solar plexus. The jejunum and ileum are supplied by the superior mesenteric vessels.

The *large intestine* (plate IV. D—I) presents on its exterior surface a sacculated appearance, and is fixed in its situation by folds of the peritonæum. Its length is to that of the rest of the canal as one to five, and is disposed so as to describe, whilst in the abdomen, an arch, the extremities of which are fixed in the iliac fossæ, the upper part or curve extending as high as the liver and stomach; whilst the terminal part descends into the pelvis, and describes another curve, corresponding with that of the sacrum. The large intestine consists of three portions, differing in length and situation, viz. the cæcum, colon, and rectum.

Cæcum.—The cæcum (plate IV. D; plate VIII. figs. 2, 3, No. 2) is fixed in the right iliac fossa, where it forms a sort of cul-de-sac, being a short rounded pouch, extended down from the colon, with which it is continuous, and receiving at its left side the ileum, which opens into it at an angle, being directed from left to right, and from below upwards. It is sometimes called *caput coli*. It is covered by the peritonæum in front and at the sides, but posteriorly it is left uncovered, where the membrane is reflected away from it. To its lower and inner part is attached a round tapering process (*appendix cæci*), which, from its resemblance to an earth-worm, is also called *appendix vermiformis*. This is about three inches long, and slightly convoluted, a small fold of peritonæum serving to retain it in that condition. Its coats are as thick as those of the cæcum, with which they are continuous, for both are lined with mucous membrane, and the muscular fibres of the one are prolonged to the other. In the early periods of fœtal life no distinction is perceptible between them; they form a long tube, projecting below the small intestine, and continuous above with the colon. But towards the time of parturition, this part of the canal becomes constricted for about two-thirds of its length, the rest retaining its natural size; and so that peculiar conformation is established which we find in after life, at least in man, and one of the higher species of the quadrumana, in whom it may be regarded as a rudiment of the tubular diverticulum which is found in the rest of the mammalia.

Colon.—The colon (plate IV. E—H), by reason of the curve it describes, presents three parts: of these one, the right or ascending part, passes up from the right iliac fossa, where it is continuous with the cæcum, as far as the inferior surface of the liver, supported on the quadratus lumborum muscle and the right kidney, its external border being in contact with the wall of the abdomen, the

internal with the convolutions of the small intestines. Another part (middle or transverse) passes across from right to left, beneath the liver and stomach, concealed by the great omentum, and supported by the ascending layer of the transverse meso-colon. And the third portion (left or descending) extends from the spleen to the left iliac fossa, where it makes a double curve, so as to resemble the letter S, placed horizontally. Hence it is termed the *sigmoid flexure* of the colon. From the point just indicated, the intestine inclines inwards, passing over the border of the pelvis, and assumes the name of "rectum." This we shall describe separately, in consequence of the peculiarities of its structure and the importance of its relations.

Structure.—The large intestine is composed of three tunics, like the rest of the canal. The serous coat (plate VII. figs. 1, 2) invests the ascending and descending portions of the colon only at the front and sides, as the posterior and inner border corresponds with the interval between the lamellæ of the meso-cola; and, as its transverse arch gives attachment to the great omentum and the transverse meso-colon, it is uncovered along these points. The external surface of the cæcum and colon is marked by three narrow lines (plate IV. No. 23; plate IX. fig. 3) running their entire length, composed of the external or longitudinal fibres of the muscular coat clustered together, and which, by being somewhat shorter than the intestine, draw it into folds or sacculi, commencing at the cæcum, and extending to the sigmoid flexure of the colon, the rectum not being marked by any such appearance; at different points are also placed appendices epiploicæ (plate VI. Nos. 28, 28) noticed already in the description of the peritonæum. The inner surface of the large intestine presents prominent lines and sacculi, corresponding with those seen on the exterior; and at the junction of the ileum with the cæcum there is a valve, which deserves particular notice.

Valvula coli; v. ilio-colica; v. Bauhini (plate VIII. figs. 2, 3).—When the large intestine is laid open along the right side, particularly if it has been partially dried, a narrow aperture, of an elliptic form, will be observed leading from the ileum into the cæcum and colon at their junction. This

PLATE X.

The anatomy of the liver.

Fig. 1. The liver seen upon its superior or convex surface, showing its general form and the attachments of its ligaments.

No. 1. The right or greater lobe. 2. The left or lesser lobe. 3, 3. The anterior or free margin of the liver. 4, 4. Its posterior or attached border. 5. Its greater or right extremity. 6. The lesser or left extremity. 7. A slight indentation upon the free margin of the right lobe, corresponding with the situation of the fundus of the gall-bladder. 8. The deep notch upon the anterior margin, which distinguishes the right from the left lobe. 9. The round ligament. 10, 10. The ligamentum suspensorium, or falciform ligament (broad), formed by two layers of peritonæum. 11. The point at which the two layers of peritonæum forming the falciform ligament separate from each other to become continuous with the lateral ligaments. 12. The left lateral ligament. 13, 13. The right lateral ligament. 14, 14. The large space upon the posterior border of the liver left uncovered by peritonæum; the surface is roughened by cellular tissue which connects the capsule of the organ at this point with the diaphragm. The peritonæum, 15, 15, surrounding this space, is the coronary ligament. 16. The inferior vena cava emerging from its fissure in the posterior border of the liver previously to piercing the diaphragm. 17. A part of the lobulus Spigelii. 18. An indentation corresponding with the convexity of the vertebral column.

Fig. 2. The inferior or concave surface of the liver, showing its subdivisions into lobes.

No. 1. The right lobe. 2. The left lobe. 3, 3. The anterior or free margin. 4, 4. The posterior or attached border. 5. The greater or right extremity. 6. The lesser or left extremity. 7. The notch upon the anterior margin of the liver. 8, 8. The umbilical or longitudinal fissure. 9, 9. The round ligament, the fibrous cord resulting from the obliteration of the umbilical vein. 10. A portion of the falciform ligament connected to the round ligament. 11. The pons hepatis, a band formed by the substance of the liver, and extending from the right to the left lobe across the umbilical fissure. 12, 12. The posterior part of the longitudinal fissure, which is called the fissure for the ductus venosus. 13. The fibrous cord resulting from the obliteration of the ductus venosus, attached posteriorly, 14, to the cellular coat of the inferior vena cava. 15, 15. The transverse fissure. 16. The trunk of the hepatic duct cut across. 17. The hepatic artery, dividing into, 18, 18, the right and left hepatic arteries. 19. The portal vein, dividing into two large branches, 20, 20, for the two lateral lobes. 21. A fibrous connexion between the portal vein and the remains of the umbilical vein, an indication of the communication subsisting between these vessels in the fœtus. 22. The fundus of the gall-bladder. 23. The neck. 24. The lobulus quadratus. 25. The lobulus Spigelii. 26, 26. The lobulus caudatus. 27, 27. The inferior vena cava lodged in a deep fissure upon the posterior part of the liver. 28. A depression corresponding with the curve of the ascending colon. 29. A depression produced by the contact of the right kidney. 30. A depression against which the right supra-renal capsule rests. 31. The rough surface of the posterior border of the liver. 32. The inferior layer of the coronary ligament. 33. The concavity corresponding with the convexity of the vertebral column.

Plate 10

Fig. 1.

Fig. 2.

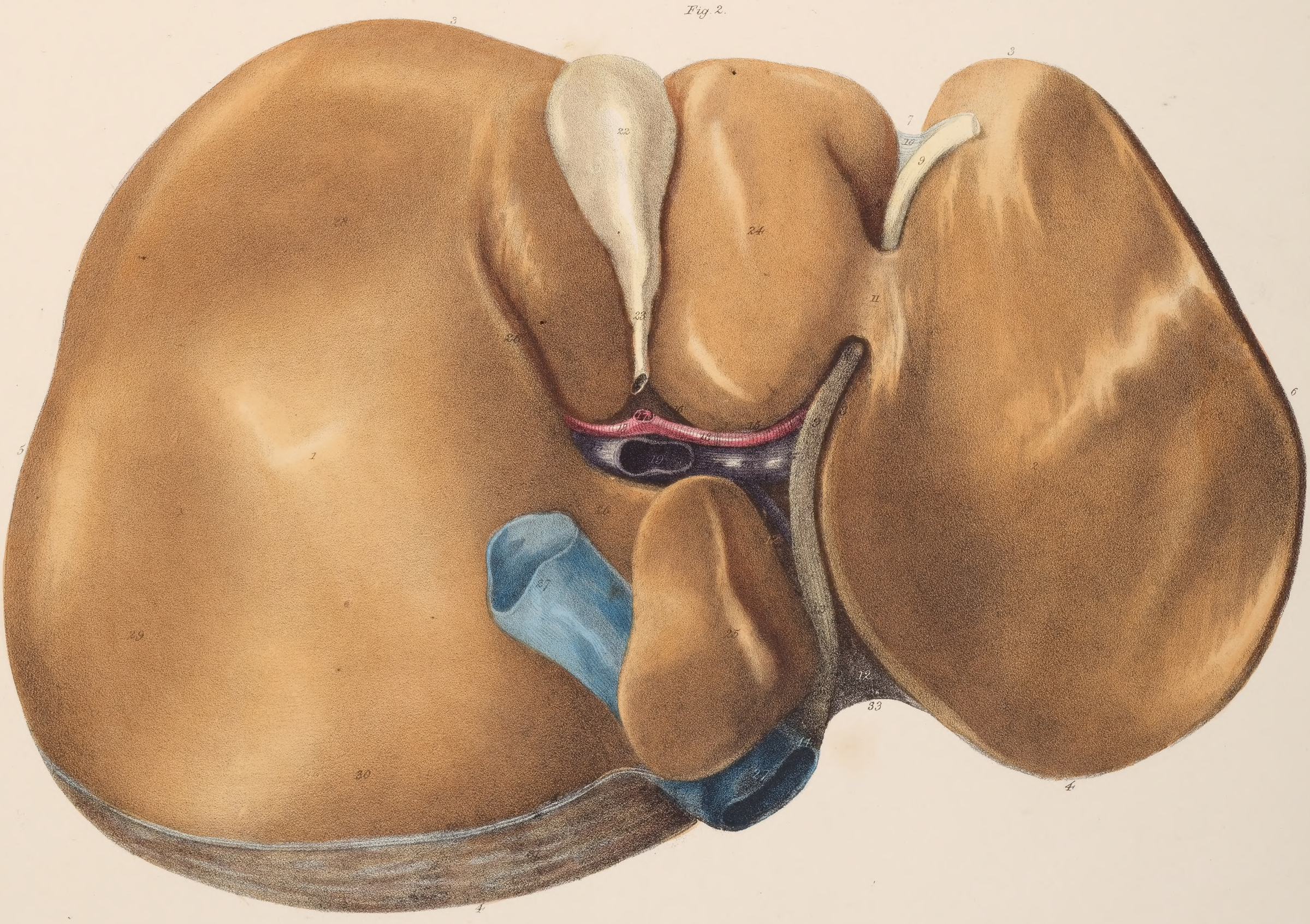

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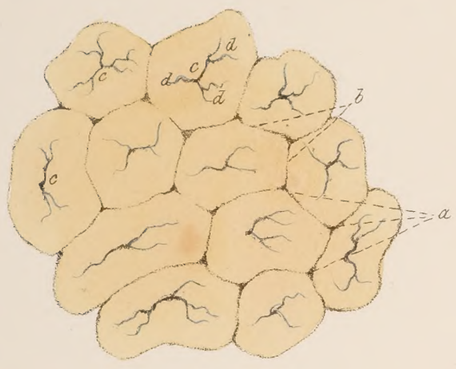
Plate 11.

Fig. 1.



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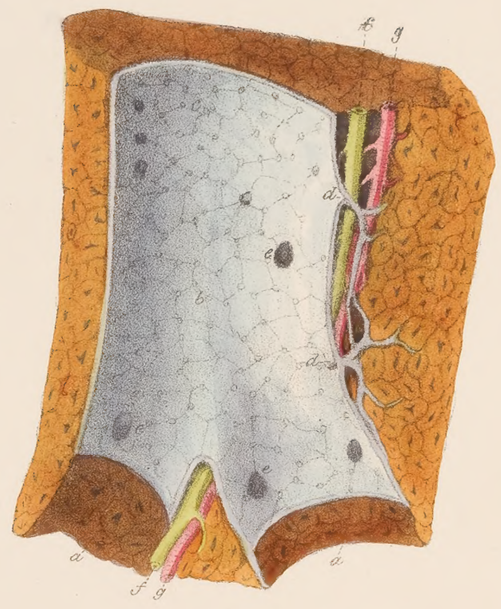

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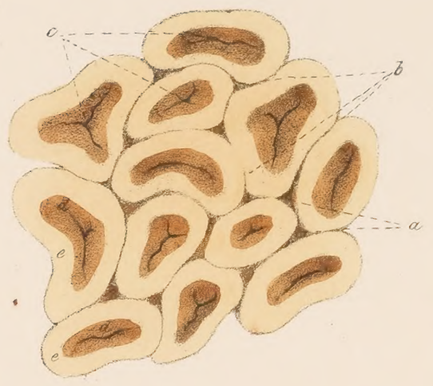

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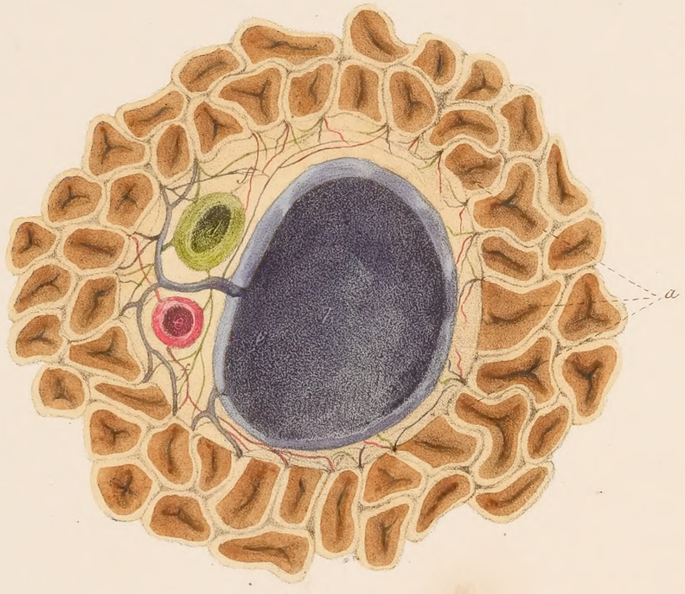

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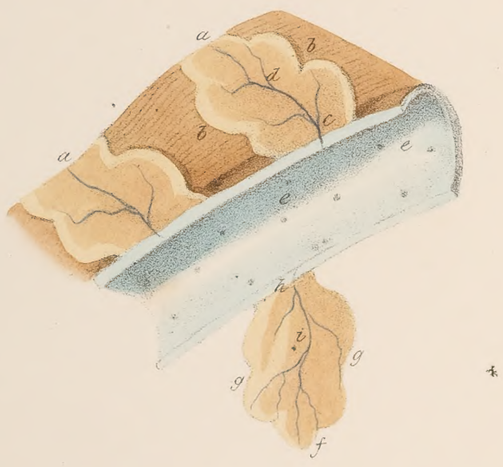

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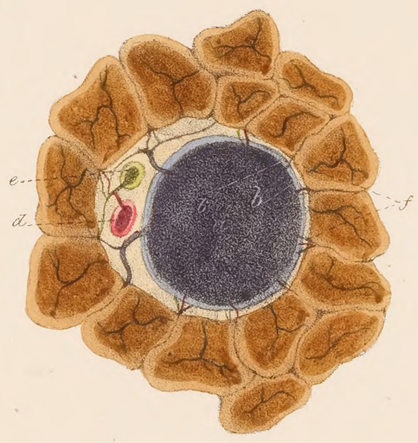

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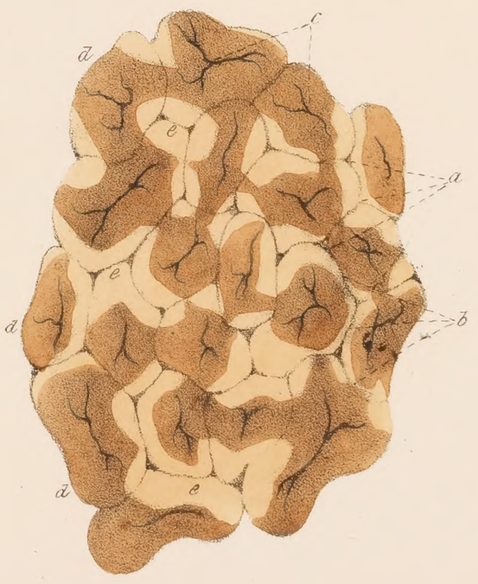
Fig. 3.



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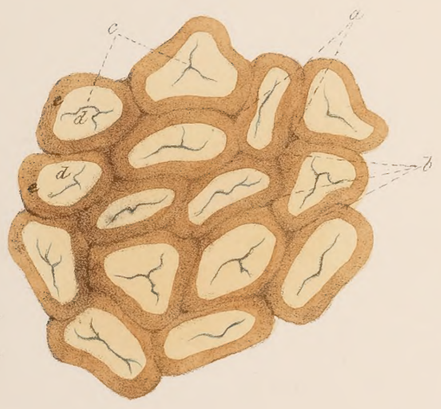

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narrowing of the canal is caused by two lunated folds which project into its interior, and form the valve. The lower fold is the larger of the two; its convex border is attached to the line of union of the ileum with the cæcum, that of the upper or smaller fold corresponds with its junction with the colon; whilst the straight margins of both project inwards, and are in apposition one with the other. Each of these is made up of the mucous membrane, the submucous cellular tissue, and the circular fibres of the ileum and large intestine projected into the interior of the canal, whilst the longitudinal

PLATE XI.

The minute anatomy and structure of the liver, after Kiernan. The drawings are copied, with Mr. Kiernan's permission, from the illustrations to his paper entitled "The Anatomy and Physiology of the Liver," published by the Royal Society in the Philosophical Transactions for 1833.

Fig. 1. A group of lobules as they appear upon the external surface of the liver; they are angular in form from compression, and from the presence of a smaller quantity of Glisson's capsule than usual. They were delineated from a liver in the state of anæmia.

a. The inter-lobular spaces, which contain the larger inter-lobular branches of the hepatic duct, portal vein, and hepatic artery. b. The inter-lobular fissures, in which the smaller inter-lobular branches of the hepatic duct, portal vein, and hepatic artery ramify. c, c. Intra-lobular veins, occupying the centres of the lobules. d, d. Smaller veins, converging to form the intra-lobular veins.

Fig. 2. A group of lobules as they appear on the external surface of the liver; they are rounded in their form, from the presence of a greater quantity of Glisson's capsule, and exhibit the first stage of hepatic-venous congestion.

The references, a, b, c, are the same as in the preceding figure. The inter-lobular spaces and fissures are larger than those represented in fig. 1, and contain more of the capsule of Glisson. d, d. The central portion of the lobule, or that immediately encircling the intra-lobular vein, is of a dark colour, from congestion of that vein and of the central portion of the lobular venous plexus. This congested part of the lobule constitutes "the medullary substance of Ferrein, the cortical substance of Autenrieth, the red substance of MM. Boulland, Andral, and other anatomists, and the cellulo-vascular substance of Mappes." e, e. "The non-congested marginal portion of the lobules, constituting the cortical substance of Ferrein, the medullary substance of Autenrieth, the yellow substance of MM. Boulland and Andral, and the granular substance of Mappes."

Fig. 3. Lobules in the second stage of hepatic-venous congestion, as they appear on the external surface of the liver.

a, b. The inter-lobular spaces and fissures. c. The congested intra-lobular veins. d, d. "Appearances produced by more extensive congestion of the lobular venous plexuses. It will be remarked that in this, as in the preceding figure, the intra-lobular veins and the central portions of the lobules are congested, but that in this figure the congestion is not confined to the centres of the lobules; that it extends to their margins, and to those branches of the portal vein which ramify in the inter-lobular fissures; the congested substance is consequently continuous, and the non-congested substance is in isolated patches. As the congestion extends from the hepatic to the portal vein, and as those branches of the portal vein contained in the fissures are smaller than those contained in the spaces, those in the fissures are congested before those in the spaces; the fissures are therefore in many parts rendered obscure, in consequence of the congested state of the smaller inter-lobular portal veins contained in them, and of the corresponding marginal portions of the lobules: the congestion not having extended to the veins in the spaces (a), those portions of the lobules immediately surrounding them are not congested. The congested portion in this figure is the red or medullary substance of Ferrein, now appearing cortical; in the preceding figure it appeared medullary: in this it is continuous throughout the liver; in the preceding figure it was in isolated patches."

e, e. "Non-congested portions of the lobules, much resembling in some parts transverse sections, and in other parts longitudinal sections of single lobules. These apparently whole bodies are composed of the non-congested, opposite, marginal portions of three or four contiguous lobules; the congestion not having extended to the portal veins ramifying in the spaces and fissures, which are seen between the different portions of which they are formed. They are of a yellowish-white or yellow colour, according to the quantity and quality of the bile they contain. These are the bodies represented by Müller, by M. Boulland, and by Dr. Hope; they are the non-congested or yellow substance, now appearing medullary and in isolated patches; in the preceding figure it appeared cortical and continuous. This is the nutmeg liver of pathologists, the hypertrophy of the red substance of M. Andral."

Fig. 4. The lobules in a state of portal venous congestion, as they appear upon the surface of the liver. This pathological appearance is of very rare occurrence, and was seen by Mr. Kiernan only in children.

The references, a, b, and c, are the same as in the preceding figures. d. "The central portion of the lobules in a state of anæmia. This is the yellow or non-congested substance appearing medullary, and arising from non-congestion of the intra-lobular veins, and of the central portions of the lobular venous plexuses. e. The marginal portion of the lobules in a congested state."

Fig. 5. A longitudinal section of a sub-lobular hepatic vein.

a. Two superficial lobules terminating by truncated extremities upon the surface of the liver. b. The capsular surface of the lobule, which is invested by Glisson's capsule. c. The base of the lobule resting upon the external coat of a sub-lobular vein, and having no covering of Glisson's capsule. d. The intra-lobular vein in the centre of the lobule. e, e. The openings of intra-lobular veins into the sub-lobular vein. f. One of the internal lobules divided by the longitudinal incision through the centre of its axis, showing its foliated

fibres and the serous coat are continued uninterruptedly from one to the other. If the two latter be divided all round externally at the angle of union, and the ileum drawn outwards, the valve will be effaced, and present a rounded or funnel-shaped opening.

Vessels and nerves.—The colon receives its arteries from the right side, or concavity of the arch formed by the superior mesenteric artery, and one also from the inferior mesenteric. Its veins terminate in those which accompany the two arteries just named. Its nerves are offsets from the mesenteric plexus (superior and inferior).

The *Rectum* (plate IV. No. 1; plate VII. fig. 1), or terminal part of the great intestine, extends from the left sacro-iliac symphysis (where it is continuous with the sigmoid flexure of the colon) to the anus, its direction being at first obliquely from left to right, as it descends to gain the middle line of the sacrum. When deep in the pelvis, it changes its direction, in order to pass forwards in front of the lower part of the sacrum and the coccyx, and behind the bladder, prostate gland, and vesiculæ seminales in the male, or the uterus and vagina in the female. When opposite the prostate, it makes its final turn, inclining downwards somewhat, so as to leave an angular interval between its upper surface and the neck of the bladder. Thus the intestine presents a lateral inclination at its upper part from left to right, and also two curves, from which it is evident that the name (rectum) given to it is ill-chosen, and calculated to convey erroneous impressions. The curves here referred to may be said to indicate a division of the rectum into three parts, differing in situation and relation to contiguous organs. That part of the intestine included between the sigmoid flexure and the first turn, which is about half its length, is covered by peritonæum in front and at the sides, and also connected by its fold (meso-rectum), though loosely, to the sacrum. The middle portion, or that between the curves, is about three inches long, its direction being forwards and a little downwards; it rests on the lower part of the sacrum, on the coccyx, and the coccygei muscles, whilst its upper

appearance. g. The capsular surface of the lobule. h. Its base resting upon the sub-lobular vein. i. The intra-lobular vein.

Fig. 6. A longitudinal section of a small portal vein and canal; the lobules are in a state of anæmia.

a, a. Portions of the portal canals from which the vein has been removed. The parietes are composed of lobules similar to those of the external surface of the liver, separated from each other by fissures and spaces. b. The portal vein, the outline of the fissures and spaces are seen through its coats. c. The mouths of inter-lobular veins, which enter the inter-lobular spaces against which they are placed, and ramify directly in the inter-lobular fissures. d, d. Two vaginal veins, which form a plexus within the portal canal, and give off inter-lobular branches to the inter-lobular spaces and fissures. e, e. The orifices of small portal veins, which enter smaller canals. f. The hepatic duct, giving off vaginal branches. g. The hepatic artery, giving off vaginal branches.

Fig. 7. A longitudinal section of an hepatic vein; the lobules are in the first stage of hepatic-venous congestion.

a. An hepatic trunk; its coats are thick and opaque, and the hepatic-venous canal in which it lies is lined by a prolongation of the proper capsule of the liver. This canal is formed by the capsular surfaces of its parietal lobules, b, b. c, c. Sub-lobular veins terminating in the hepatic trunk. The coats of these veins are thin and transparent, so that the outline of the lobules with their spaces and fissures may be seen through them. d. The mouths of intra-lobular veins opening through the centres of the bases of the lobules. e, e. Longitudinal sections of the lobules, showing the intra-lobular vein opening directly into the sub-lobular vein. f, f. Portions of the sub-lobular canals from which the vein is removed; the form of the bases of the lobules, with the intra-lobular veins opening through the centre of each, is seen. These canals are formed wholly by the bases of the lobules. g, g. The openings of other sub-lobular veins.

Fig. 8. A transverse section of a large portal canal and its vessels. The lobules are in a state of general congestion, their central portions being more congested than their marginal portions.

a. Superficial lobules forming the parietes of the canal. They are similar to those of the external surface, fig. 5, a; being perforated by their intra-lobular veins. b. Section of a portal vein. c. Vaginal branches forming a vaginal plexus, from which the inter-lobular branches are given off. d. Section of an hepatic duct, from which vaginal branches are given off to form a vaginal plexus. e. Section of a branch of the hepatic artery, also giving off vaginal branches. f, f. The vaginal plexus, formed by the vaginal branches of the portal vein, hepatic duct, and artery. The white substance in which the plexus ramifies is Glisson's capsule, which completely surrounds the vessels in the large canals, but is most abundant on the side corresponding with the artery and duct.

Fig. 9. Transverse section of a small portal canal. The lobules are in a state of general congestion.

a. The portal vein, a great portion of which is in apposition with the inter-lobular spaces on the parietes of the canal. b. The inter-lobular veins arising from the portal trunk, and entering the inter-lobular spaces with the inter-lobular duct and artery, without forming a plexus in the canal. c. Two vaginal branches, forming a plexus in the canal, from which the inter-lobular branches are given off. On this side the vein resembles a large portal vein in being separated from the walls of the canal by a vaginal plexus enveloped in Glisson's capsule. d. The hepatic duct giving off vaginal branches. e. The hepatic artery giving off vaginal branches. f. Three vessels,—a vein, a duct, and an artery entering each inter-lobular space on the surface of the canal.

surface lies immediately beneath the base of the bladder and the prostate gland, being separated from the former on either side by the vesiculæ seminales, and between them merely by some loose cellular tissue. This part is stripped altogether of the peritonæal coat at the side as well as posteriorly, and it remains only for a very little way upon its upper surface, for it becomes reflected off it opposite the points at which the ureters impinge on the base of the bladder. Now, in the situation here indicated, the peritonæum forms a small cul-de-sac as it is being reflected, the base of which projects forwards somewhat beyond the level of the ureters, forming a lunated fold (if the parts be viewed laterally), whose concavity looks forwards. The third portion of the intestine extends from opposite the prostate gland to the anus, its length being from an inch to an inch and a half, its direction downwards and backwards. At its commencement it is close to the under surface of the prostate gland; it soon becomes invested by the internal sphincter muscle, and embraced by the levatores ani, at the same time contracting its diameter towards its termination, where it is surrounded by the external sphincter muscle.

Structure (plate IX. fig. 3).—The relation of the peritonæal coat to the intestine having been already sufficiently indicated, we may observe, with regard to the muscular tunic, that the longitudinal fibres, which are considerably developed, are not aggregated into fasciculi as in the colon, but disposed equally all round the tube of the intestine, just as they are in the œsophagus, so that in this particular not a little similitude exists between these two parts of the alimentary canal. At the lower portion of the gut the longitudinal fibres cease, whilst the circular set becomes proportionally developed, so as to form what is termed the internal sphincter muscle. The mucous membrane is thicker and much more vascular than it is in the colon, and presents three prominent folds at different points. One projects backwards from the upper and fore part of the tube, where it corresponds with the prostate gland, the second from its side at the second curve, the third higher. The position, and the degree of projection of these folds, should be attentively considered; they must necessarily exert a material influence on the introduction of instruments.* No doubt they have been often taken for strictures. In reference to this matter, also, the lateral deviation and the curves above noticed should likewise be studied.

Vessels and nerves.—The rectum receives arteries from three sources: from the inferior mesenteric, its superior hæmorrhoidal branches; from the internal iliac, or from one of its principal branches, the middle hæmorrhoidal; and from the pudic, the external hæmorrhoidal. The veins are very numerous, and form a complex interlacement (hæmorrhoidal plexus), which communicates with the internal iliac vein by branches accompanying the middle hæmorrhoidal artery, and with the inferior mesenteric vein. The nerves are also numerous, and derived from two sources; from the cerebro-spinal system it receives several filaments, which come from the sciatic plexus, also from the pudic nerve. From the sympathetic system numerous branches also are derived, which come from the inferior mesenteric plexus, and also from the hypogastric plexus.

The Liver.—The liver (plate X; *hepar*, *jecur*) is of considerable size; it occupies the right hypochondriac, and part of the epigastric region, extending also somewhat into the left hypochondriac, and so will be found placed beneath the diaphragm, above the stomach and arch of the colon, behind the cartilages of the ribs, and before the spine,—the aorta, the vena cava, and crura of the diaphragm being interposed. In this situation it is retained by four folds of peritonæum, called *ligaments*, viz. the falx, or falciform fold (fig. 1, Nos. 10, 10), on its upper surface; and the coronary (15, 15), and two lateral ones (12, 13), placed at its posterior border. These have been already described with the other processes of the peritonæum.

When examining the form of the liver, it is necessary to consider separately each of its surfaces, borders, and extremities.

The *superior* surface (fig. 1), smooth and convex in its general outline, corresponds with the arch of the diaphragm, and is divided by the falx into two parts or lobes, named, from their position, the *right* and *left* lobes, the former being considerably the larger.

The *inferior* surface (fig. 2) is irregularly concave, and presents certain fissures, eminences, and depressions, deserving of notice.

1. *Right and left lobes.*—The division of the liver into right and left lobes, which is indicated upon the upper surface by the falx or suspensory ligament, is here marked by a fissure (fig. 2, Nos. 8, 8; 12, 12) which extends from the anterior to the posterior border. The right lobe (figs. 1 and 2, No. 1) is considerably larger than the left; it occupies the right hypochondriac region, whilst the other (figs. 1 and 2, No. 2) is placed in the epigastric and left hypochondriac; the proportion as to size between the former and latter is about five or six to one.

* Mr. Houston's Dublin Hospital Reports, vol. v.

2. The *umbilical fissure.*—Extending from before backwards, a deep groove or fissure will be observed (fig. 2, Nos. 8, 8; sulcus umbilicalis—longitudinalis, horizontalis), which in fœtal life lodges the umbilical vein in that part of its extent which reaches from the anterior border to the transverse fissure, whilst the remaining portion (12, 12) transmits the ductus venosus. In after life both these degenerate into ligamentous cords. This fissure is in some instances converted into a canal, by a portion of the substance of the liver (fig. 2, No. 11; *pons hepatis*) being extended across it.

3. The *transverse fissure.*—Running transversely with regard to the preceding, and at right angles with it, is a second fissure (fig. 2, No. 15; sulcus transversus; s. venæ portæ). It occupies the middle third of the transverse diameter of the liver, being somewhat nearer the posterior than the anterior border. The older anatomists likened it to a gateway, which gave transmission to the portal vessels, as it lodges the vena portæ, the hepatic artery and biliary ducts, with the nerves and lymphatics.

4. The *square lobe.*—In front of the transverse fissure a square piece is marked off (fig. 2, No. 24; lobulus quadratus), which is bounded behind by the fissure just named, before by the margin of the liver, on the left by the longitudinal fissure, and on the right by the gall-bladder.

5. The *pyramidal* or *Spigelian lobe.*—Behind the transverse fissure, and concealed by the hepatic vessels and small omentum, is situated another lobe (fig. 2, No. 25; lobulus Spigelii); it projects in the form of a pyramidal mass, forming a sort of promontory between the three great veins, or rather the fissures which lodge them, viz. the vena portæ, vena cava, and the umbilical vein. Its base is connected with the right lobe by a process, which is named *lobulus caudatus* (fig. 2, No. 26). This lobule has before it the transverse fissure, and behind it another which lodges the inferior vena

PLATE XII.

The minute structure of the liver, and the anatomy of the gall-bladder.

Fig. 1. Three of the lobules of the liver, showing the distribution of the portal and hepatic vein within the lobule.—From Mr. Kiernan's paper.

a, a. The inter-lobular (portal) veins entering the inter-lobular spaces. b, b. The inter-lobular veins contained in the inter-lobular fissures, and forming venous circles around the lobules. "This is the appearance which the venous circles present when examined with a common magnifying glass: they are, however, formed by numerous, and not by single branches, as represented in the figure." c, c. "The lobular venous plexuses, the branches of which, communicating with each other by intermediate vessels, terminate in the intra-lobular veins. The circular and ovoid spaces seen between the branches of the plexuses are occupied by portions of the biliary plexuses, constituting the acini of Malpighi." d, d. Intra-lobular veins, the commencement of the hepatic veins; formed by the union of branches from the plexuses.

Fig. 2. "represents the inter-lobular ducts entering the lobules, and forming the lobular biliary plexuses."—After Kiernan.

"a. Two lobules. b, b. Inter-lobular ducts. c, c. Inter-lobular cellular tissue; *i. e.* Glisson's capsule. d, d. The external portions of the lobular biliary plexuses injected. e, e. The intra-lobular branches of the hepatic vein. f, f. The uninjected central portions of the lobules." "No such view of the ducts as that represented in this figure can be obtained in the liver. The inter-lobular ducts are in the figure seen anastomosing with each other; I have never seen these anastomoses, but I have seen the anastomoses of the ducts in the left lateral ligament, and, from the results of experiments related in this paper, I believe the inter-lobular ducts anastomose. I have never injected the lobular biliary plexuses to the extent represented in the figure."

Fig. 3. "represents the biliary ducts ramifying in the left lateral ligament of the liver."—After Kiernan.

a, a. The posterior edge of the left lobe of the liver. b. The free edge of the ligament. c. The edge which is attached to the diaphragm. d, d. "Biliary ducts emerging from the liver, and ascending to ramify in the ligament. e. Arches formed by the ducts towards the upper part of the ligament. f. The plexuses formed by the minute ducts."

Fig. 4. A small hepatic duct laid open in order to show the two rows of follicles; discovered by Kiernan.

a, a. The rows of muciparous follicles.

Fig. 5. The gall-bladder removed from its connection with the liver.

a. The body of the gall-bladder. b. The fundus. c. The neck, from which the anterior segment has been removed in order to show the arrangement of the spiral valve contained within it, and formed by the mucous membrane. d. The cystic duct. e. The hepatic ducts of the right and left lobes of the liver. f. The common hepatic duct. g. The ductus communis choledochus. h. The constriction upon the extremity of this duct where it is passing between the muscular and mucous coats of the duodenum. i. The trunk of the pancreatic duct opening into the ductus communis choledochus at its termination.

Fig. 6. A small portion of the internal surface of the gall-bladder, showing the reticulated rugæ upon its mucous membrane. In the fossæ between the rugæ the muciparous follicles (a, a) are distinctly seen.

Fig. 7. Portions of the columnar epithelium of the mucous membrane of the gall-bladder.—After Henle.

a. Lateral view of a group of these columns. b. A group of columns seen by their free extremities, exemplifying the mode in which they are compacted to produce the smooth surface of the membrane. c. Isolated columns.

Plate. 12.

Fig. 1.

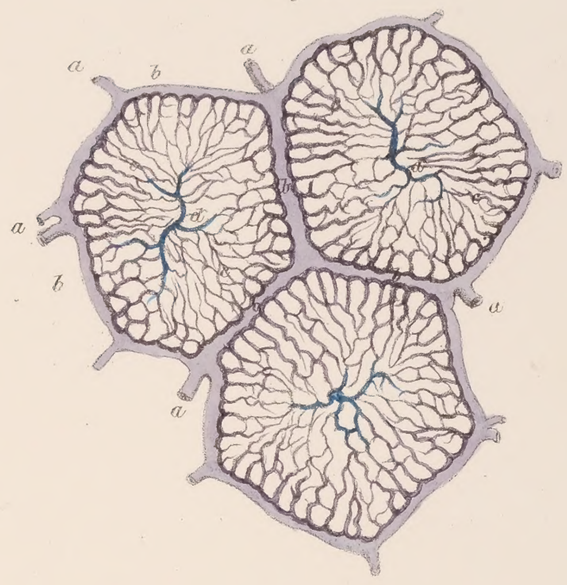


Fig. 2

Fig. 5

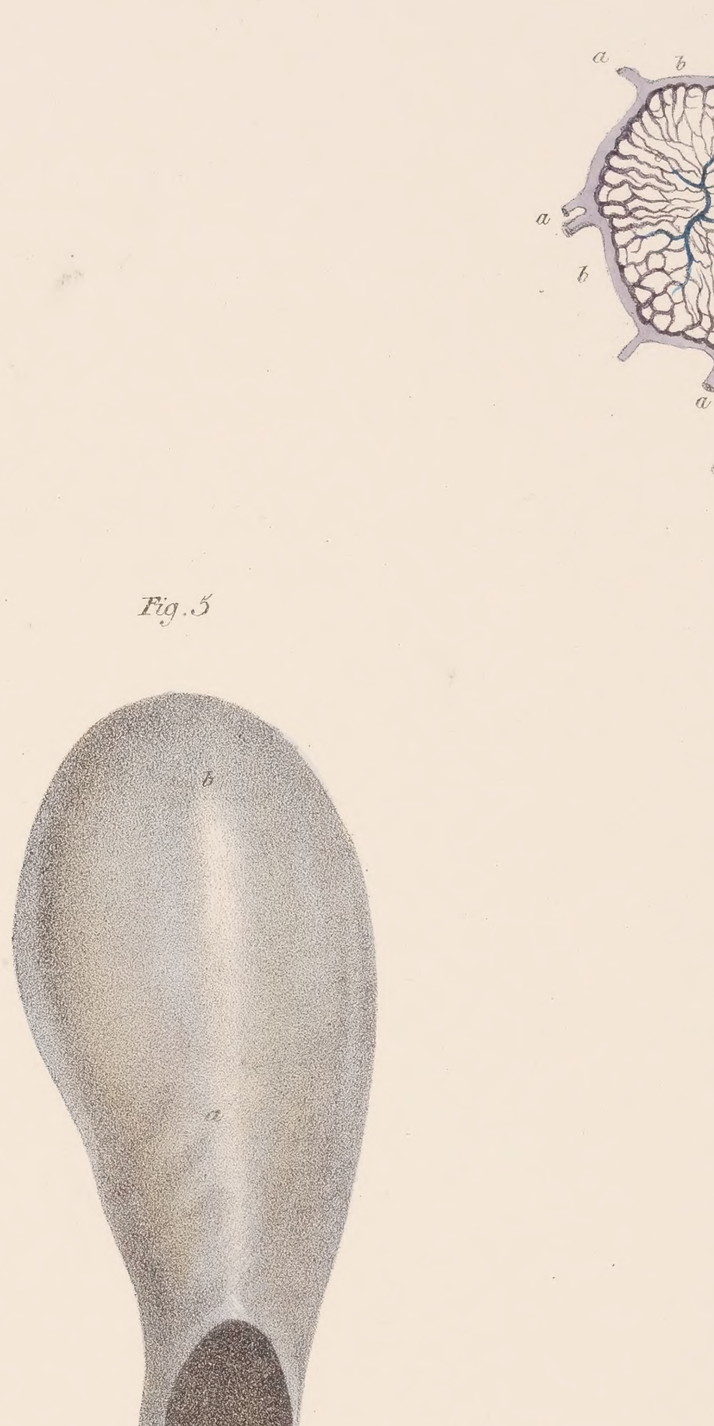
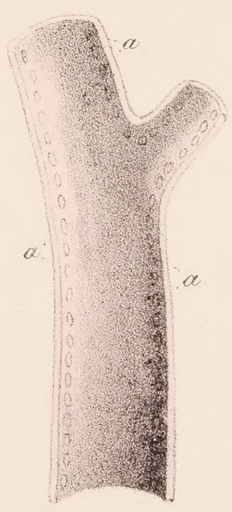


Fig. 4.



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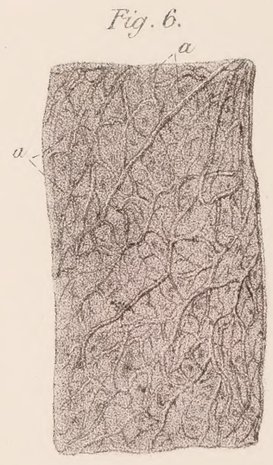

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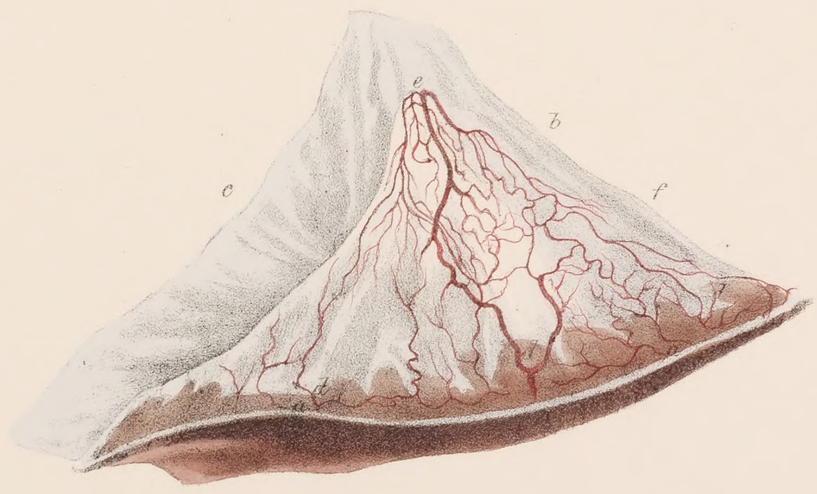

Fig. 7.

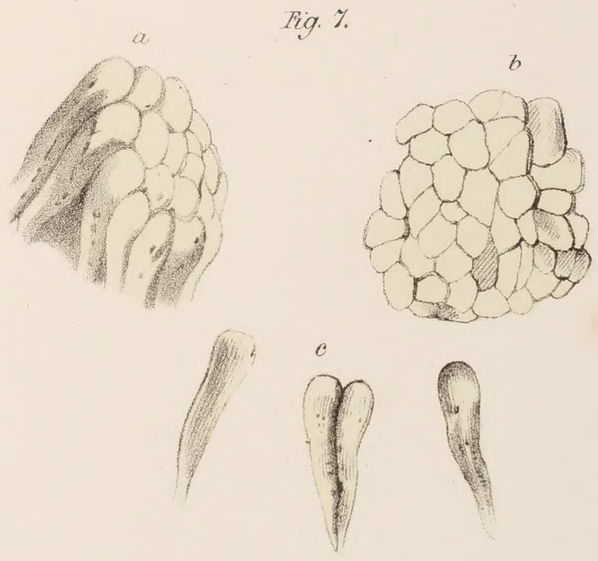

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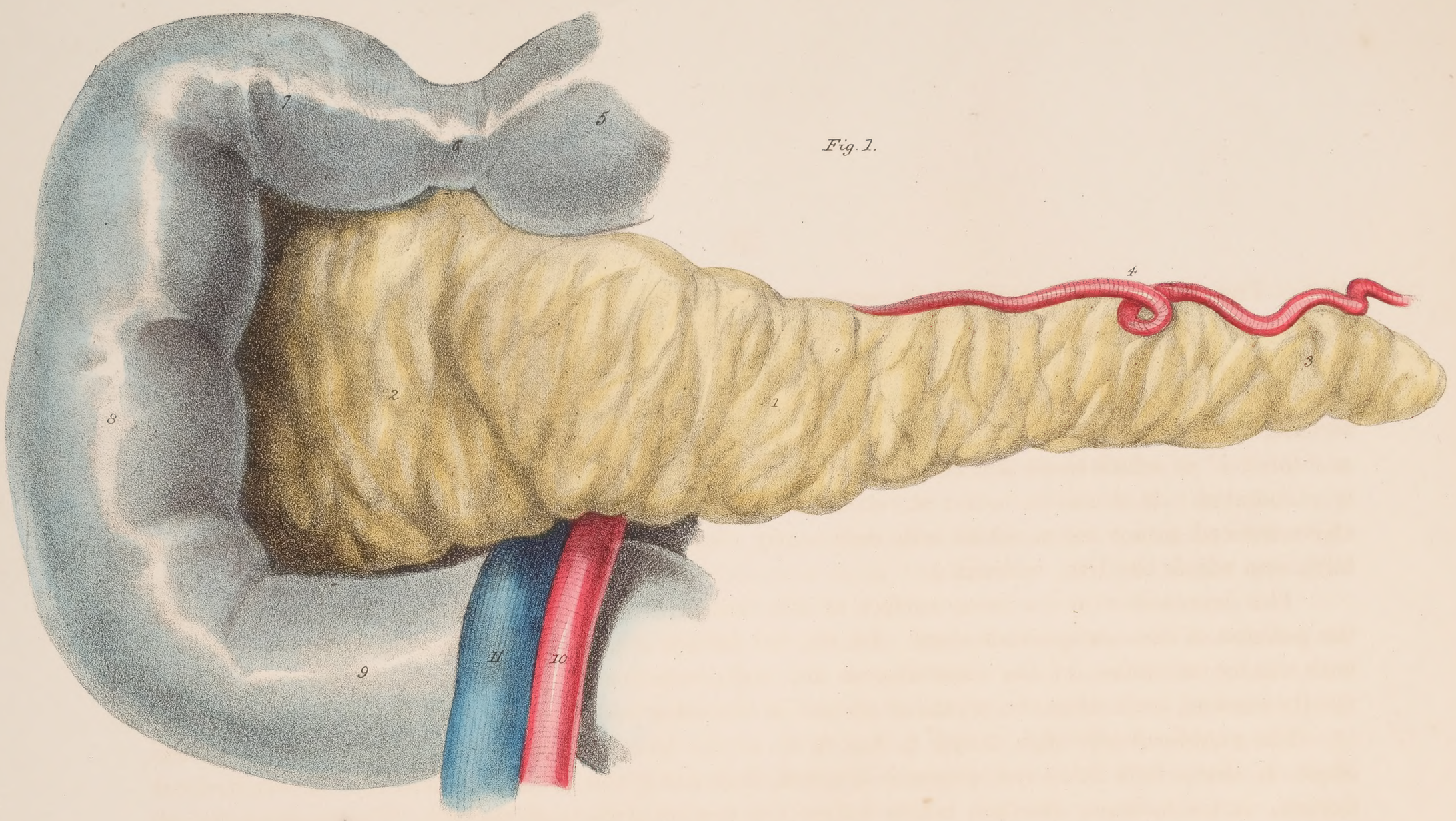
Plate 13.

Fig. 1.



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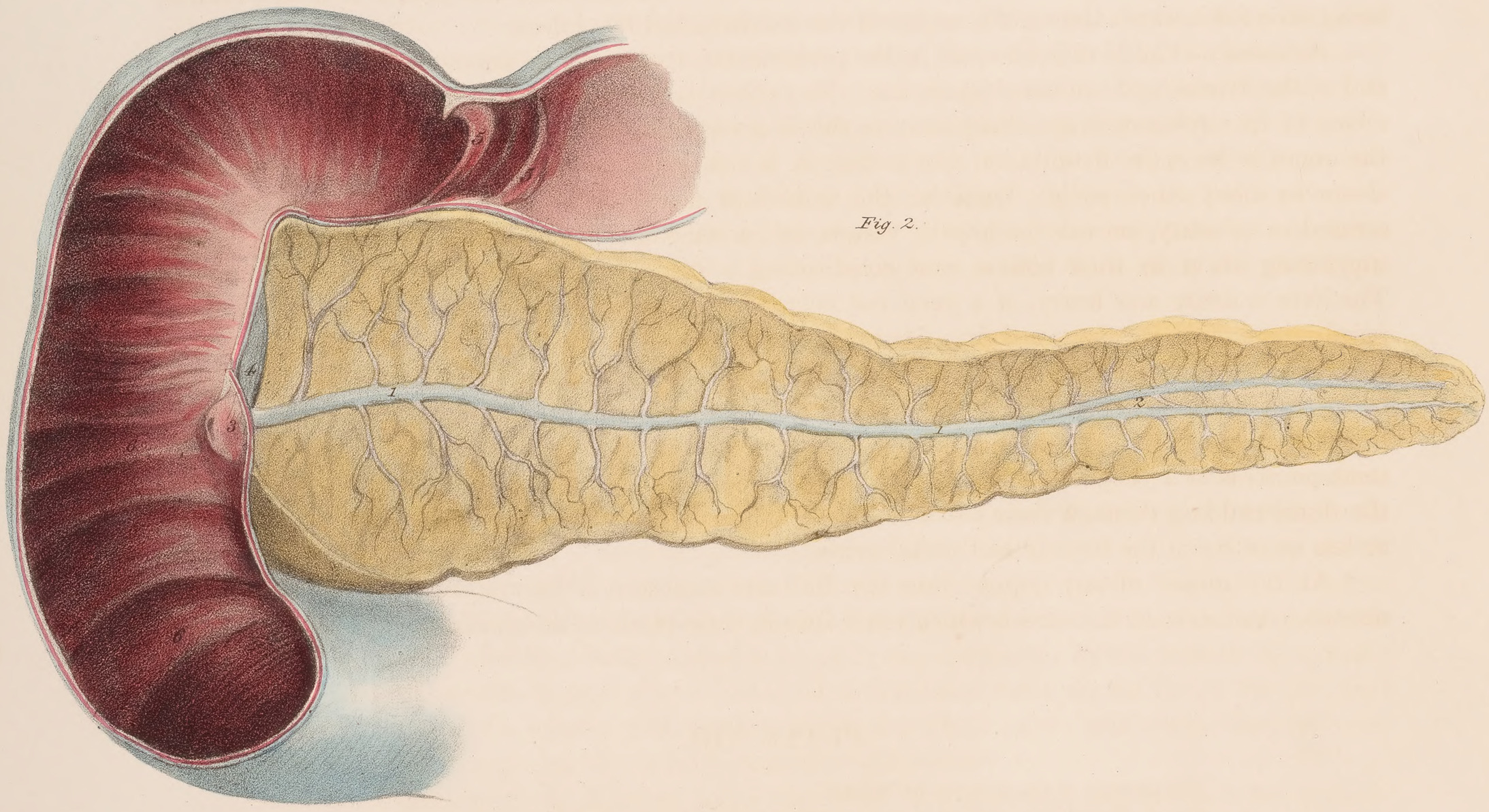

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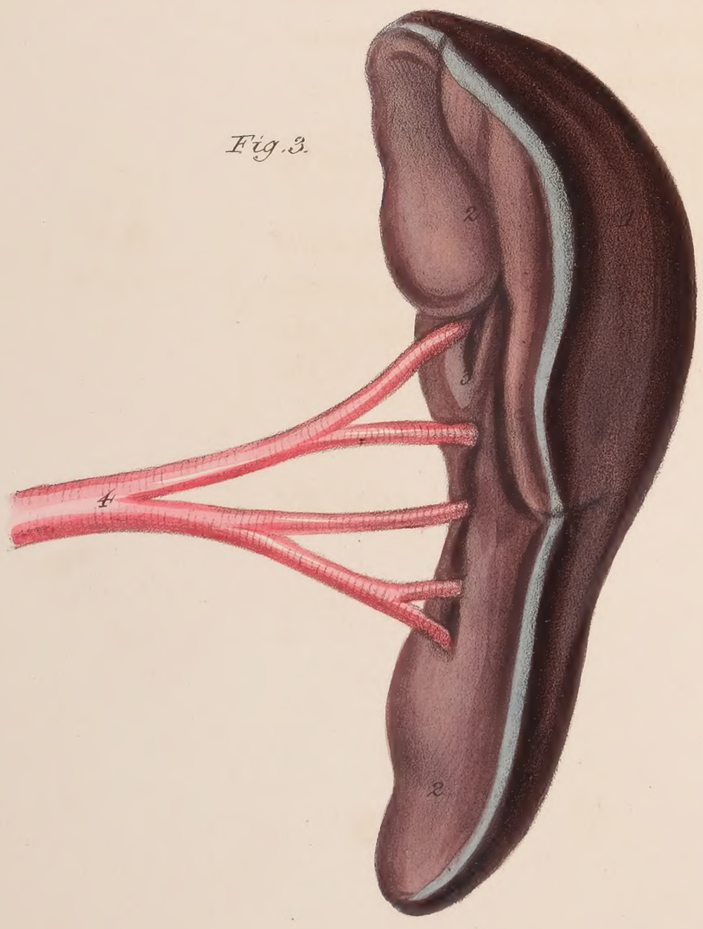

Fig. 4.

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cava. The square and pyramidal lobes were formerly likened to the *pillars* of a gate, and the transverse fissure to a gateway (*porta*) for the entrance of the vessels; from this the great vein, *vena portæ*, took its name.

Some confusion arises from applying the term "lobulus" to the portions of the liver here described, viz. lobulus Spigelii—quadratus—caudatus, at the same time that we speak of the "lobuli" or "lobules" of which these and all other parts of the liver are composed, and in which its secretion is elaborated. It would be better to restrict the term to the minute lobules, and call the masses above noticed minor lobes, which will sufficiently distinguish them from the great lobes (right and left), into which the liver is divided.

The depressions on the lower surface of the liver are very slight; they merely correspond with the position of the contiguous viscera. In the left lobe a depression will be observed corresponding with the upper surface of the stomach; on the right, one for the gall-bladder, and two others, very faintly marked, indicating the points of contact of the colon and the right kidney.

The *anterior border* (figs. 1 and 2, Nos. 3, 3) of the liver, which lies beneath the margin of the chest, is sharp and thin, and presents a notch, indicating the commencement of the longitudinal fissure; and sometimes another, which lodges the fundus of the gall-bladder. The *posterior and superior border* (figs. 1 and 2, Nos. 4, 4) is thick and rounded; it is marked by two grooves, of which one, broad and superficial, indicates where it rests on the spine, the other transmits the vena cava. The right extremity (5, 5) is rounded and thick; the left (6, 6), on the contrary, is thin and oblique, being directed towards the cardiac orifice of the stomach, and the spleen.

Structure.—The liver is invested by the peritonæum, except at the points of reflection of the falx and of the lateral and coronary ligaments. Its surface is throughout smooth and shining, which is owing to its serous covering. Subjacent to this is a very thin lamella of cellular tissue, which invests the organ in its entire extent; on the surface it is not more developed than the sub-serous cellular tissue in many other parts. Opposite the transverse fissure, however, it becomes considerably increased in quantity, encases the hepatic vessels, and accompanies them throughout their ramifications, supporting them in their course, and constituting a nidus for them when they become capillary. The liver is dense and heavy, of a deep red colour, or a brownish red, with very frequently a slight purple tinge along its sharp margin. Its weight is about four pounds; its transverse diameter is from twelve to thirteen inches, its thickness about five or six. When torn or divided, the surface exposed by the fracture presents a granular appearance, as if it were made up of minute granules or lobules, from which circumstance the liver has been classed amongst the conglomerate glands. Its colour in some points is of a yellowish tinge, in others of a dusky red; the former being caused by the bile of the ducts exuding through their coats, the latter is obviously owing to the blood retained in greater or less quantity in the hepatic and portal veins.

At the outset of any inquiry into the intimate structure of this or of any other organ, it is necessary to ascertain the vessels which enter into it, their mode of distribution, and mutual relations.

PLATE XIII.

The anatomy of the pancreas and spleen.

Fig. 1. The pancreas viewed upon its anterior surface with its relation to the duodenum.

No. 1. The body of the pancreas. 2. The head of the pancreas. 3. Its small extremity. 4. The splenic artery, lying along the upper border of the pancreas, and making several curves in its course. 5. The pyloric extremity of the stomach. 6. The pylorus. 7. The ascending portion of the duodenum. 8. The descending portion. 9. The third, or horizontal portion. 10. The trunk of the superior mesenteric artery. 11. The superior mesenteric vein.

Fig. 2. A dissection of the pancreas, showing the excretory duct with its branches; the duodenum is laid open by a longitudinal incision.

Nos. 1, 1. The pancreatic duct. 2. Two branches from the small extremity of the gland uniting at an acute angle. 3. The papilla upon which the pancreatic duct opens into the duodenum. 4. The ductus communis choledochus, advancing from behind the duodenum to open upon the same papilla. 5, 5. A section of the spiral fold of mucous membrane situated at the pylorus. 6, 6. Valvulæ conniventes, of small size in the duodenum.

Fig. 3. The spleen, seen in the position which it occupies in the abdomen.

No. 1. Its convex surface. 2, 2. The concave surface. 3, 3. The hilus lienis, or groove through which the vessels pass to supply the organ. 4. The splenic artery, dividing into branches.

Fig. 4. The convex surface of the same spleen.

No. 1. Its anterior border, upon which is seen one of the clefts generally found in this part of the organ. 2. Another cleft upon its upper extremity.

Those of the liver may be stated as follows: 1. The *vena portæ* (fig. 2, Nos. 19, 20, 20) conveys into it the residual blood from all the chylo-poietic viscera. Its branches (right and left) spread out like arteries in the corresponding sides of the liver, until they become capillary in its granular structure. 2. The *hepatic veins* commence by radicles continuous (as may be shown by injection) with the terminations of the vena portæ. These gradually enlarge as they pass upwards, converging to the point at which the vena cava passes behind the liver, and pour their contents into that vein (fig. 2, Nos. 27, 27). They are usually three in number; their direction is upwards and inwards, converging towards the sulcus which lodges the vena cava; and most of them have also an inclination from before backwards, inasmuch as they have to pass from the anterior surface to the posterior border. These veins are, moreover, so intimately connected with the substance of the liver, that they do not collapse when cut across; and finally, they proceed to their destination unaccompanied by any other vessel. From this it must be obvious that the hepatic veins cross those of the vena portæ, which not only diverge towards the lateral masses of the liver, but also have to come forwards to its anterior surface. 3. The *hepatic artery* (fig. 2, Nos. 17, 18, 18), arising from the cœliac, ascends to the transverse fissure, where it divides into two branches, which accompany those of the vena portæ to their terminations. 4. The *nerves*, forming a plexus (*hepatic*) round the artery and veins, are derived from the great solar plexus. 5. The *lymphatics* are exceedingly numerous; some being extended upon its surfaces, others arising from its interior, the latter following the course of the blood-vessels. 6. The *hepatic or biliary duct* (fig. 2, No. 16; ductus hepaticus — biliarius) arises by minute ramusculi in the lobules, where they are intimately connected with those of the vena portæ, whose branches they accompany as they converge towards the transverse fissure, out of which issue two branches, one for the left lobe, the other for the right; these soon unite, and by their union they form the duct. It consists of two coats or tunics, of which the external is fibrous and the internal mucous. 7. A lamella of cellular membrane encloses the vena portæ, the hepatic artery, and the duct, previously to their entrance into the fissure, and accompanies them to their final termination, loosely connecting them to the substance of the organ. This has been called the *capsule of Glisson*, who supposed it to possess a contractile, and even a muscular power, and on this hypothesis sought to explain the portal circulation.*

Such are the anatomical elements of which the liver is composed, its proximate constituents being the granules or lobules above noticed. These were supposed by Malpighi to be hollow in the interior, and to form follicles, or *acini*, interposed between the capillary terminations of the vena portæ and of the artery, and the incipient radicles of the hepatic duct;—a conjecture which is invalidated by the fact, that injections passed into the vein return by the duct without appearing to suffer extravasation. Ruysch, on the contrary, supposed them to be solid, and to consist of an interlacement formed by the capillaries of the different orders of vessels. Now, when we consider the course of the vessels, and of the fluids they contain, we perceive that two sorts of blood are brought to each lobule by the portal vein and hepatic artery, the former conveying materials for the secretion of bile, the latter for the nutrition of the organ; and that a different sort of blood is conveyed away by the hepatic vein, whilst at the same moment a new fluid (the bile) is received and carried down by the duct; so that each lobule forms the centre of a minute eddy within which the fluids turn; and where they not only change their direction, but also receive a total alteration of character.

The recent researches of Mr. Kiernan give a very clear view of several points connected with the distribution of the vessels in the liver, and particularly of the structure of the lobuli. It is obvious that the interior of the organ is channeled or hollowed into two sets of canals; the one giving lodgment to the hepatic veins; the other to the portal vein, its branches, and the accompanying arteries and ducts. At the transverse fissure, the vein, duct, and artery divide into branches which enter the portal canals. These divide and subdivide into smaller branches, which enter the smaller canals; and every canal, however small, contains an offset from the portal vein, the hepatic artery, and the duct. These are enclosed by Glisson's capsule, which lines the portal canals, and forms sheaths for the larger vessels, and a web in which the smaller vessels ramify; it enters the inter-lobular fissures, forming capsules for the lobules, and finally extends into their interior, and with the blood-vessels expands itself over the secreting biliary ducts. "The capsule thus presents three portions—a vaginal —inter-lobular—and lobular portion; and as the vessels ramify in the capsule, their branches admit of a similar division."

The hepatic ducts can be traced along the canals, in the fissures between the lobules, and into the lobules where they form plexuses. "These may be called the lobular biliary or secreting plexuses,

* Glisson, de Anatomiâ Hepatis.

as being the immediate agents in the secretion of bile." The branches of the portal vein and the hepatic arteries also enter the lobules. The venous branches form a plexus which communicates with the incipient radicles of the hepatic vein; and the arteries, which are very few and very minute, are the nutrient vessels of the lobules, and probably terminate in the plexus of the portal vein. The branches of the artery ramify freely upon the coats of the portal vein, and on the hepatic ducts, furnishing materials for the nutrition of both, and to the latter for the secretion of mucus which lubricates their interior.

The trunks of the hepatic veins are lodged in the "hepatic venous canals." Their incipient radicles commence in the interior of the lobules, so that each lobule may be said to be "sessile" upon a minute venous branch. Hence when a hepatic vein is laid open, the orifice of each minute branch which terminates in it is seen to come out of the middle of a lobule; but the branches of the portal vein, when viewed in the same way, correspond with the interstices between the lobules.

Structure of the lobules.—Each lobule is found to consist of a reticulated plexus formed by the minute radicles of the biliary ducts; for these, when examined with a high magnifying power, are seen to divide and subdivide so as to form a mesh in its interior, which is supported by a nidus of cellular tissue furnished by Glisson's capsule. Upon this mesh or plexus is disposed another, formed by the terminal branches of the portal vein. This is the "lobular venous plexus," from which that formed by the ducts can be distinguished, as the latter presents somewhat the appearance of cells. The branches of the venous plexus converge from the circumference of the lobule towards its centre, and communicate with the incipient radicles of the hepatic vein.

It is difficult to inject the ducts, owing to their being filled with bile. Mr. Kiernan succeeds by first tying the portal vein and hepatic artery in a living animal after feeding it. By this expedient the secretion of bile is suspended, and that which the ducts contain is discharged. The ducts cannot be injected directly from the hepatic vein, for no branches of this vessel ramify on their coats. Whenever it does reach the ducts, it is only through the branches of the portal vein which spread upon them. And even when the ducts are injected from the portal vein or the hepatic artery, the fluid gets into their interior by rupturing their lining membrane.

The residue of the blood conveyed by the hepatic artery to the lobules, to the different vessels, and the ducts for their nutrition, is taken up by minute veins and conveyed into the portal vein, so that part of the blood from which bile is secreted is derived from the liver itself.—(See Mr. Kiernan's paper.*)

The *gall-bladder* (plate XII; vesicula fellis) is a membranous sac, of a pyriform shape, lodged in a slight depression at the inferior surface of the right lobe of the liver. Its position is oblique, so that its fundus inclines downwards, and to the right side, being on a level with the lower margin of the liver, whilst its body and neck are directed backwards, upwards, and to the left. Its neck tapers gradually, and is prolonged into a small tube (*ductus cysticus*, κυστις, vesica,) which at first inclines inwards and backwards, then descends and joins at an angle with the hepatic duct to form a common canal, (*ductus communis choledochus*, χολη, bile, δεχομαι, to receive,) which lies on a level with the hepatic artery, and on the same plane, the vena portæ being behind and between both. The common duct is about three inches long, it descends behind the pylorus, insinuates itself between the descending part of the duodenum and the head of the pancreas, with whose duct it comes into contact, and both together pierce the coats of the duodenum, running for three quarters of an inch between them, previously to terminating on the inner surface of that intestine. The gall-bladder is composed of two coats, united by a lamella of cellular membrane: the external one is but a partial covering, being derived from the peritonæum; the internal is a mucous lining, continuous with that in the ducts. In the neck of the sac the mucous membrane projects inwards, so as to form folds, disposed spirally, and calculated not only to favour the ascent of the bile into its reservoir, but also to graduate its flow as it descends. If the pipe of a syringe be inserted into the hepatic duct, the duodenum being at the same time laid open, and the fundus of the gall-bladder cut off, water forced along it will be found to ascend into the latter almost as soon as it appears in the intestine. This would indicate a resistance to its course at the mouth of the common duct, which is produced by a small valvular fold of membrane, placed within the orifice. The effect of the spiral lamella in the gall-bladder can be readily perceived by the manner in which the fluid ascends contrary to its gravity.

The Spleen.—The spleen (lien, splen) is a soft, spongy, and exceedingly vascular organ, placed in the left hypochondriac region, between the diaphragm and the stomach, and beneath the cartilages of the ribs. Its colour is deeply red, with a tinge of blue, particularly round its margin. Its form is

* Philosophical Transactions, 1833, part ii.

somewhat oval, being smooth and convex on the exterior, where it is in apposition with the diaphragm, and irregularly concave on the opposite side, which is divided into two parts, but unequally, by a longitudinal slit (*hilus lienis*) for the transmission of its vessels. The spleen has a peritonæal investment prolonged to it from the stomach, by which, as well as by vessels, it is connected to that organ; but it has also a smooth and fibrous tunic proper to itself. Its size is very variable, not only in different individuals, but also in the same person. Taking a general average, its greatest diameter measures about four inches, its breadth three, and its thickness from two to two and a half; its weight from eight to ten ounces. Its consistence is so slight that it is easily torn, and in many cases it is found soon after death so soft as to be readily broken down by a slight pressure, when it appears a grumous, dark, confused mass.

Structure.—The fibrous or proper coat of the spleen is so firmly adherent to the serous investment, that they cannot be separated, except at its concave surface. From its interior, a multitude of cellular bands and fibres project, which form, by their intersections, cells of various forms and sizes. The splenic artery and vein are both of very large size compared with the bulk of the organ. They ramify minutely in its interior, and freely communicate, which is proved by the facility with which injections pass from one to the other. Its nerves are derived from the solar plexus forming an interlacement (splenic plexus) previously to their entrance into it; its lymphatic vessels are very numerous; but as there is no appreciable product elaborated by this apparatus, it has no excretory duct; and as no necessary dependence or connexion has hitherto been established between it and any other organ (for it has been extirpated from dogs without causing death, or even, in some cases, any very material disturbance of their functions), the purpose which it serves in the animal economy remains altogether unknown. Besides the cellular structure and vascular arrangement above indicated, several minute granular bodies are scattered through the substance of the spleen, of a whitish colour, but variable in size and form.

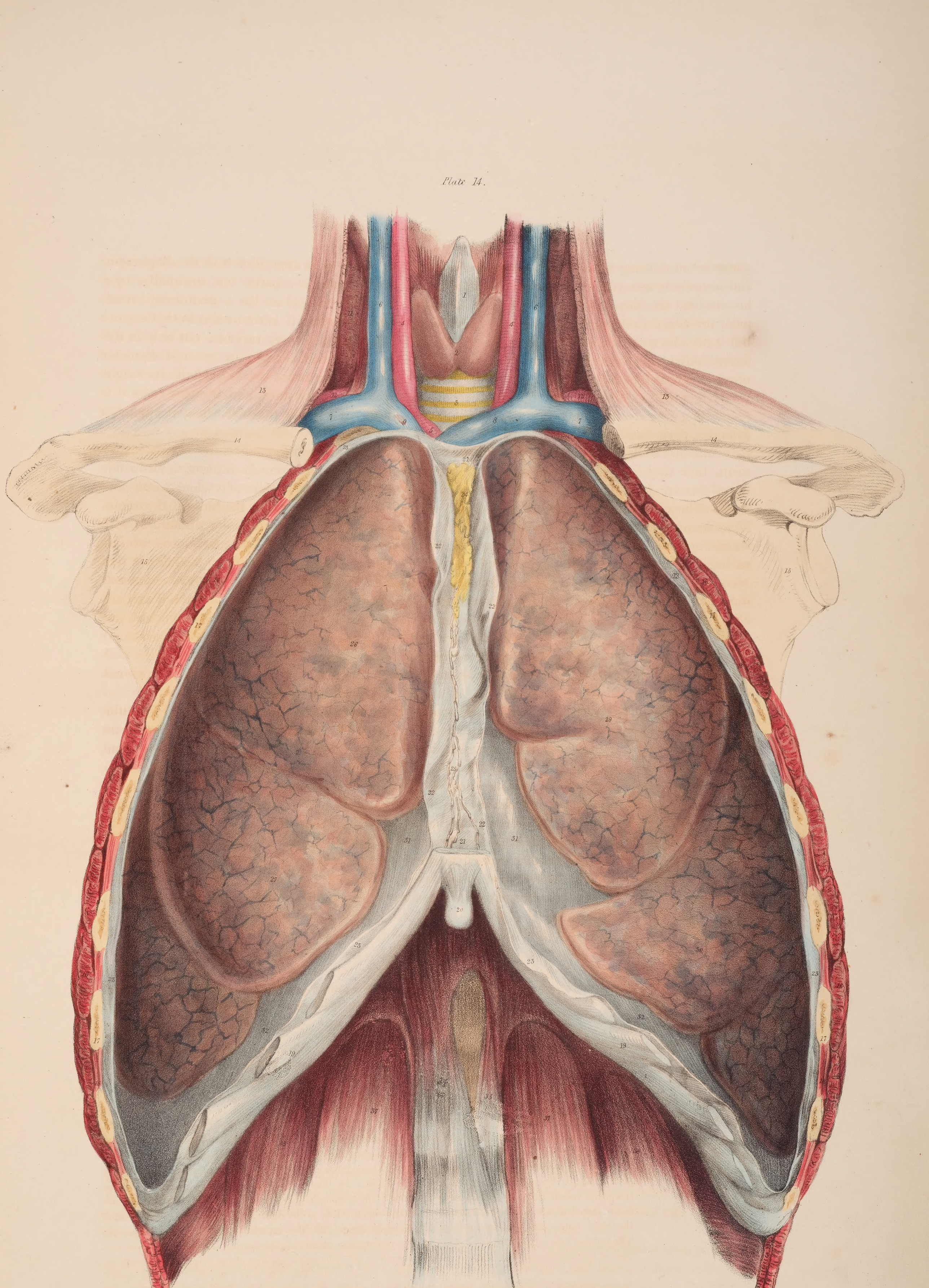
The Pancreas.—The pancreas is a conglomerate gland, being composed of a number of granules aggregated together; in which respect, as well as in its function, it resembles the salivary glands, with which it is classed. The greater part of it lies deeply in the epigastric region, resting on the spine, the great vessels interposing, and concealed by the stomach, one end being in contact with the spleen, and therefore lying in the left hypochondrium, the other surrounded by the curve of the duodenum, so that its direction is obliquely downwards, and to the right side. The gland is compressed and flat, and, after the stomach is drawn upwards, it will be found still covered by the ascending layer of the transverse meso-colon. The superior mesenteric artery will be observed interposed between its lower surface and border and the transverse part of the duodenum, and along its superior and posterior margin run the splenic vessels. The left, or splenic extremity, is narrow and thin; the right is broader, and called the *head* of the pancreas; a small part of it is also detached somewhat from the rest, and called

PLATE XIV.

The anatomy of the organs of respiration—the lungs. In this plate the lungs are seen to occupy their natural position in the chest; the view has been obtained by removing the anterior wall of the thorax, after dividing the ribs on each side, and the costal cartilages below.

No. 1. The prominence of the thyroid cartilage. 2. The thyroid gland. 3. The trachea. 4, 4. The common carotid arteries. 5. The upper border of the arteria innominata. 6, 6. The internal jugular veins. 7, 7. The subclavian veins. 8. The left vena innominata. 9. The right vena innominata. 10, 10. The anterior scaleni muscles. 11, 11. The sterno-mastoid muscles, divided by a vertical section. 12, 12. The subclavian arteries in the third part of their course. 13, 13. The trapezius muscle at each side, in outline. 14, 14. A part of the clavicle at each side. 15, 15. The scapula at each side, in outline. 16, 16. The divided serrations of the serratus magnus muscle. 17, 17. The divided extremities of the ribs. 18, 18. The intercostal muscles. 19, 19. The costal cartilages, forming the lower boundary of the chest. 20. The ensiform cartilage. 21, 21. The anterior mediastinum, separating the two sides of the chest. 22, 22. The two layers of the reflected pleura, forming the lateral boundaries of the anterior mediastinum. 23, 23. The pleura costalis, lining the internal surface of the chest. 24. The remains of the thymus gland. 25. Some lymphatic vessels from the liver passing upwards to the lymphatic glands at the root of the neck; the number is placed near to a lymphatic gland. 26. The superior lobe of the right lung. 27. The middle lobe of the right lung. 28. The inferior lobe of the right lung. 29. The superior lobe of the left lung. 30. The inferior lobe of the left lung. 31, 31. The pericardium concealing the heart. 32, 32. The upper surface of the diaphragm lined by the pleura parietalis. 33. The aortic opening of the diaphragm, formed by its two crura. 34. The right crus of the lesser muscle. 35. The left crus. 36, 36. The ligamentum arcuatum internum at each side, beneath which is seen passing the psoas muscle, 37, 37. 38, 38. The quadratus lumborum at each side.

Plate 14.



W. J. E. Wilson, direxit.

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Wm. Richards, Engrg.

Plate. 15.

Fig. 1.

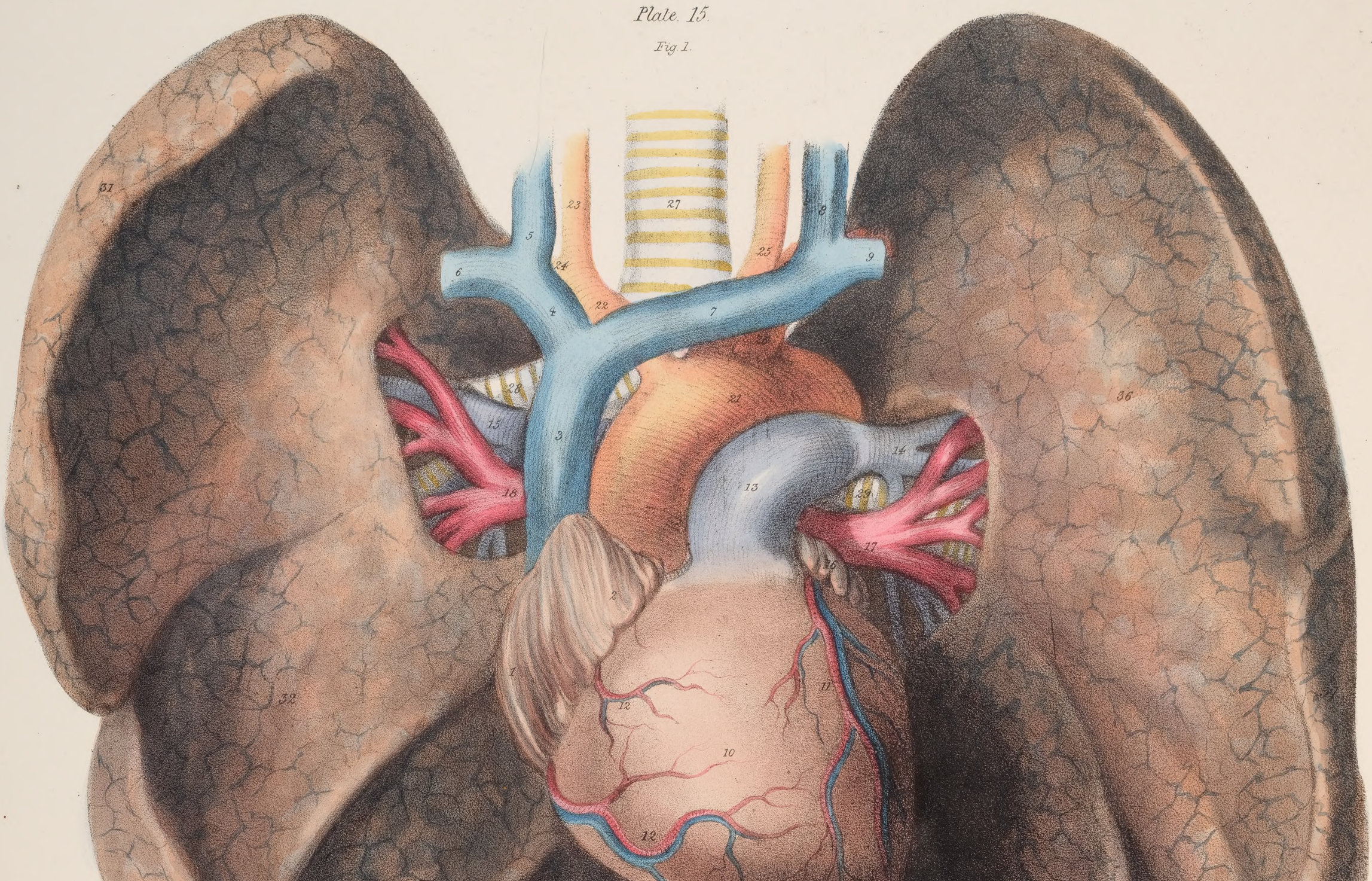

Fig. 2.

the *lesser pancreas.* Its excretory duct (*ductus pancreaticus*) commences by filaments which issue from the different granules, and gradually increases in size as it proceeds from left to right through the substance of the gland, and will be found nearer the lower than the upper border ; near its extremity it is joined by the duct of the smaller pancreas. When arrived at the right border of the gland, the duct comes into close apposition with the ductus communis choledochus, with which it pierces obliquely the coats of the duodenum, and becomes identified with it, so that both terminate by a single orifice which opens on the inner surface of the duodenum at the junction of its second and third portions.

Structure.—The globules of which this gland is composed are aggregated into bundles, and these connected so as to form a mass by cellular tissue, which, however, does not constitute a proper capsule for it. It is of a pale ash-colour, about six inches long, one and a half in breadth, and from half an inch to three quarters in thickness. Each granule seems to contain within itself all the elements of a secreting organ ; in its interior is a minute cell or cul-de-sac, being the ultimate radicle of the excretory duct ; around which is a minute vascular plexus—all supported and connected by cellular tissue, in which also run filaments of nerves. The arteries of the pancreas come from the splenic, pancreatico-duodenalis, and root of the mesenteric ; the veins open into the splenic ; the nerves are offsets from the solar plexus.

After the organs of digestion, those of absorption follow, when taken in their physiological order, as they take up the product of digestion and convey it into the current of the circulation. We have already described the absorbing vessels and their common trunk (thoracic duct), so that we may now continue our route, and proceed to the circulating system.

We shall premise a few remarks on the thorax, previously to describing the organs which it contains.

PLATE XV.

The organs of respiration and circulation,—the lungs and heart.

Fig. 1. An anterior view of the lungs and heart, with their great vessels.

No. 1. The right auricle of the heart. 2. The appendix auriculæ. 3. The superior vena cava. 4. The right vena innominata 5. The right internal jugular vein. 6. The right subclavian vein. 7. The left vena innominata. 8. The left internal jugular vein. 9. The left subclavian vein. 10. The right ventricle. 11. Branches of the left coronary artery and great cardiac vein ramifying along the anterior ventricular groove. 12, 12. Branches of the right coronary artery and anterior cardiac veins. 13. The pulmonary artery. 14. The left pulmonary artery, passing into the root of the left lung. 15. The right pulmonary artery, entering the right lung. 16. The appendix of the left auricle. 17. One of the left pulmonary veins. 18. One of the right pulmonary veins. 19. The left ventricle. 20. The ascending aorta. 21. The arch of the aorta. 22. The arteria innominata, dividing into, 23, the right common carotid artery, and, 24, the right subclavian artery, of which the commencement only is seen. 25. The left common carotid artery. 26, 26. The left subclavian artery. 27. The trachea. 28. The right bronchus. 29. The left bronchus. The bronchus, with the large vessels, 15 and 18, on the right side, and 14 and 17, on the left side, constitutes the root of the corresponding lung. Their relative situation to each other from before backwards is the same on both sides ; the pulmonary veins, 17, 18, being the most anterior ; next, the pulmonary arteries, 14, 15 ; and then the bronchi, 28, 29. From above downwards, on the right side, the bronchus, 28, is the highest ; next, the pulmonary artery, 15 ; and then the pulmonary veins, 18. And on the left side, first the pulmonary artery, 14 ; then the bronchus, 29 ; and then the pulmonary veins, 17. 30. The superior lobe of the right lung ; its internal or concave surface. 31. Its external and convex surface. 32. The concave surface of the middle lobe of the right lung. 33. Its convex surface. 34. The inferior lobe. 35. The inferior surface of the inferior lobe of the right lung. 36. The internal surface of the superior lobe of the left lung. 37, 37. Its external surface. 38. The inferior lobe of the left lung.

Fig. 2. A posterior view of the lungs and heart, showing the relation of the great vessels.

No. 1. The membranous part of the trachea : the granulations upon its surface are the tracheal glands. 2. The right bronchus. 3. The left bronchus. 4. The left auricle. 5. One of the right pulmonary veins. 6. One of the left pulmonary veins. 7. The root of the other left pulmonary vein. 8. The posterior aspect of the left ventricle. 9. The inferior vena cava, cut short near its connection with the right auricle. 10. The right pulmonary artery, entering the root of the right lung. 11. The left pulmonary artery. 12. The superior vena cava. 13. The vena azygos, cut short just as it is about to arch over the right bronchus and terminate in the superior vena cava. 14. The right vena innominata. 15. The right subclavian vein. 16. The right internal jugular vein. 17. The trunk of the arteria innominata. 18. The right subclavian artery. 19. The right common carotid artery. 20. The left vena innominata. 21. The left subclavian vein. 22. The left internal jugular vein. 23. The left common carotid artery. 24. The left subclavian artery. 25. The trunk of the aorta, cut through just as it is about to arch over the root of the left lung. 26. The superior lobe of the left lung. 27. The inferior lobe. 28. Its inferior surface. 29. The internal or cardiac surface. 30, 30. The superior lobe of the right lung. 31. The posterior part of the middle lobe. 32. The inferior lobe of the right lung. 33. A part of its inferior surface, which rests on the diaphragm. 34. Its internal or cardiac surface.

THE THORAX.

The thorax is somewhat conical in its form, and intended to lodge the central organs of circulation and respiration. It is intermediate not only in size and situation, but also in the structure of its walls, between the abdomen and the cranium; the one being composed almost entirely of soft parts, and the other an osseous case, whilst the thorax consists of muscular and osseous parts in nearly equal proportions. The spaces between the ribs are filled by the intercostal muscles. The base is formed by the diaphragm. In the natural condition, when the scapulæ and arms are attached to the trunk, the top of the chest is wider than the bottom; but when these parts are detached, and nothing remains but the walls of the cavity, the proportions are reversed, for it appears a truncated cone, the summit being above. The upper aperture is bounded at each side by the first rib, before by the top of the sternum, behind by the spine. Its breadth from side to side is greater than its depth from before backwards. Its plane, or line of direction, is backwards and upwards; through it pass the great arteries and veins of the head and upper extremities, the trachea, œsophagus, vagus and sympathetic nerves, the thoracic duct, sterno-hyoid and sterno-thyroid muscles anteriorly, and the longi colli posteriorly. The base of the thorax is also oblique; its inclination, however, being from before backwards and downwards; hence the depth of the cavity is greater behind than before. The breadth of the base from side to side is greater than its depth. The thorax, in the natural condition, is divided into two lateral chambers by a partition (mediastinum) formed by the reflection of the pleuræ; it extends from the summit to the base of the cavity, and from the sternum back to the spine. It may be likened to a hollow partition, composed of two parallel planes, leaving an interval between them which lodges the vessels, nerves, and tubes above enumerated, and transmits those which pass down to the abdomen.

ORGANS OF CIRCULATION.

When treating of the general anatomy of the vascular system, we have given an outline of the apparatus of circulation. It remains for us in the present section to describe the central organ of the circulation (the heart), with its investing membrane (pericardium).

Pericardium.—The pericardium, or "heart-purse," (περι and κηρ, the heart,) is a membranous sac which invests the heart, and the commencement of the large arterial and venous trunks which are connected with it. It is composed of two layers, the external being fibrous, the internal serous: it is situated above the central aponeurosis of the diaphragm, behind the sternum and the cartilages of the third, fourth, and fifth ribs of the left side, before the bronchi, œsophagus, and descending aorta, and between the reflected layers of the pleuræ, which separate it from the lungs. Though the two membranes of which the pericardium is composed are intimately united, still their general conformation, as well as their structure and properties, are so different that it is impossible to describe them together; we must, then, notice each separately.

The *fibrous* membrane, dense, thick, and unyielding, consists of fibres which interlace in every direction. Most of them are attached to the central aponeurosis of the diaphragm, and superiorly, where they embrace the large vessels, they form tubular prolongations, which, after passing for some way upon them, become blended with their external coats; of these, eight are usually enumerated, viz. one for the superior vena cava, four for the pulmonary veins, one for the aorta, and two for the right and left branches of the pulmonary artery. As the inferior vena cava opens into the right auricle as soon as it penetrates the diaphragm, it cannot be said to receive an investment in the same way as the other vessels.

The internal or *serous* lamella of the pericardium represents a shut sac partially inverted on itself, and so disposed as that the internal or inverted part embraces the heart, whilst the other lines the inner surface of the fibrous lamella. It was the great simplicity of arrangement observable in the serous pericardium, as contrasted with that of other membranes of the same class, that suggested to Bichât the idea of comparing it to a double night-cap; for if the heart could be drawn out of it without injury to its continuity, it would resemble an elongated sac closed on all sides, and we should then have demonstrative proof, that, though that organ is invested by the membrane, it is still without its proper cavity.

The Heart.—The heart (cor, κηρ), the central organ of the circulation, is a hollow muscle, irregularly pyramidal in its shape, which lies between the lungs, enclosed in its proper investment, the pericardium. It is placed so obliquely, that if a line corresponding with its axis were passed through

it at the moment of its pulsation, its direction, taken from base to apex, would be downwards, forwards, and to the left side. The anterior surface of the heart is convex in its general outline; the posterior is flat, and rests on the diaphragm: the lower, or right border, is rather thin, and longer than the upper, which is rounded. The heart's surface is marked on its anterior and posterior aspect by two lines, of which one runs transversely, the other from above downwards; their position indicates the division of the organ into four different compartments, or cavities. The base of the heart (which is comparatively thin and flaccid in its structure) consists of that part which is in immediate connexion with the veins (*pars cordis venosa*), and is divided into two cavities, called auricles, from the fact that each is surmounted by an appendage resembling an ear (*auricula*). It is separated from the lower or pyramidal part by a deep transverse groove (*sulcus auriculo-ventricularis*). These circumstances are most distinctly observable when the heart is distended. The portion between the transverse sulcus and the summit is thick and muscular, and connected with the arterial trunks; it consists of two cavities (ventricles), the division between which is indicated by two slight grooves extending from the base to the apex, and lodging the descending branches of the coronary vessels.

When we consider the heart in its physiological relations, we adopt a different mode of division; for we find it to be a double organ, made up of two hearts, one for the pulmonary circulation (cor pulmonale), occupying the right side, and consisting of an auricle and a ventricle; the other for the system at large (cor systemicum), also consisting of two cavities of the same denomination. The pulmonic heart is the agent for the circulation of black blood, the systemic circulates red blood. Now, as no two of these cavities agree in form or in the arrangement of their components, it becomes necessary to describe each separately.

The *right auricle* rests on the diaphragm, and forms the right and anterior part of the base of the heart. It presents two parts, which, though not marked off by any precise line of division, yet differ in size and form. One of these, large and flaccid, occupies the interval between the venæ cavæ, so as to receive directly the blood which they convey, and is hence named *sinus venarum cavarum* The other projects forwards and inwards, between the right ventricle and the root of the aorta, like an appendage to the general cavity; and so it is sometimes named "auricular appendage," but more frequently *auricula*, from some resemblance to a dog's ear. It is triangular in form, compressed, and slightly dentated at its border. It is thicker and more fleshy than the sinus.

The external surface of the auricle, unattached in the greater part of its extent, is prolonged upwards, and to the left side, into its auricular appendage; inferiorly, it is connected with the right ventricle, internally with the left auricle: into its upper extremity opens the vena cava superior; and into the lower, the inferior vena cava.

In order to examine the interior of the auricle, an incision may be made from the junction of the cavæ across to the auricula, from the middle of which another may be carried upwards into the superior cava. If the lower border of this incision be drawn forwards, the cavæ will be observed to incline inwards at an angle, their conflux being marked by a slight elevation, called *Lower's tubercle* (tuberculum Loweri). The greater part of the cavity forms a pouch (*sinus*), which is smooth, and but slightly muscular in its structure. The inner surface of the auricula is distinguished from the rest by several fleshy fasciculi, which run transversely upon it, called *musculi pectinati*. The inner side of the auricle is thin and smooth; it corresponds with or is formed by the partition (*septum auricularum*) which separates it from the left auricle. At its lower part, and just above the orifice of the inferior vena cava, is situated an oval depression, (*fossa ovalis, vestigium foraminis ovalis,*) indicating the original communication between the auricles: it is bounded superiorly by a prominent convex border of a lunated form, its concavity looking downwards, and named *annulus fossæ ovalis*. Though the developement of the septum be carried to the full extent, that lamella of it which closes the foramen ovale having extended up to a level with the annulus, we often find its upper border merely in apposition, but not united by adhesion to the corresponding part of the septum, so that an oblique or valvular aperture remains between the auricles; still, during the action of the organ, there is sufficient provision against any communication between these cavities. At the line of union between the inferior cava and the auricle is situated a crescentic fold of the lining membrane, called *valvula Eustachii*. This in the fœtal state is large; in the adult it is comparatively diminutive, and often even perforated by several foramina. One border of the valve rests upon the wall of the auricle, with which it is continuous. Another is free and unattached, being of a crescentic form; its upper extremity blends itself with the inner border of the annulus ovalis, and the inferior with the corresponding part of the orifice of the vena cava inferior. Between this valve (its left side) and the

ventricular opening is situated the orifice of the coronary vein, protected by a valve. Several minute foramina may also be observed in different parts of the auricle, resembling the orifices of small veins, and called *foramina Thebesii*. Placed obliquely between the appendix and the inferior cava, we observe the *auriculo-ventricular opening*, of an elliptic form, and about an inch in diameter; round its circumference is attached the base of the tricuspid valve, the rest of which lies in the cavity of the ventricle.

The *right ventricle* (ventriculus pulmonalis) extends from the base of the right auricle to the apex of the heart. Its form is somewhat triangular: to see its interior it will be found convenient to make an angular or V-shaped flap, by dissecting up its anterior wall. When this is done, we observe that the interior surface presents a number of rounded fleshy fasciculi, which are called *columnæ carneæ*, and are divisible into three orders. The first, adherent by both extremities, are free in the rest of their extent; others are but slightly prominent, being attached by their extremities, and also by the greater part of their circumference; the third set form three or four fasciculi, which are directed from the summit towards the base of the ventricle, where they are connected with the borders and apices of the tricuspid valves, through the medium of several tendinous processes, called *chordæ tendineæ*. The base of the ventricle is prolonged upwards: its surface becoming at the same time quite smooth, somewhat in the form of a funnel, where it gives attachment to the pulmonary artery; so that the mouth of this vessel is placed higher up, and to the left of the auricular opening. At its orifice three membranous folds are placed, called *sigmoid valves*. One border of these is attached at the line of union of the ventricle with the artery; the other is free in the cavity of the latter, and presents in its middle a small granule, called *nodulus* or *corpus Arantii*. The *tricuspid valve* is so called from its being divided into three points or processes, formed by the lining membrane of the auricle and ventricle. Each is triangular in its form; their bases, which are continuous and undivided

PLATE XVI.

Anatomy of the lungs and pleura.

Fig. 1. A section of the chest, showing the relative position of its viscera and large vessels, with the reflections of the pleuræ.

No. 1. The divided surface of the sternum. 2, 2. Divided extremities of two costal cartilages. 3, 3. The upper borders of two ribs, forming the boundaries of the section. 4. The upper surface of a dorsal vertebra. 5. Section of the spinal cord. 6. Section of the right lung: its superior lobe. 7. Section of the middle lobe. 8. Section of the superior lobe of the left lung. 9. Section of its inferior lobe. The structure of the lung is seen upon the surface of these sections. 10, 10. The pleura pulmonalis of the two lungs. 11, 11. The point of reflection of the pleura from the surface of the lung upon its root, and thence upon the mediastinum. 12, 12. The pleura lining the external surface of the pericardium at each side. 13, 13. The two layers of the pleura reflexa, leaving between them the space, 14, which is called the anterior mediastinum. 15, 15. The pleura costalis. 16, 16. The pleura at each side, forming the lateral boundaries of the posterior mediastinum. 17, 17. The sympathetic nerve at each side, lying between the pleura costalis and the necks of the ribs. 18, 18. The cavity of the pleura at each side. 19. The heart, occupying its natural position in the chest; in the middle mediastinum. 20, 20. The pericardium; the figures are situated in the cavity of the pericardium. 21, 21. The phrenic nerve on each side of the pericardium, situated between that layer and the pleura. 22. The left ventricle; the figure 19 is placed upon the right ventricle. 23. The left appendix auriculæ. 24. The right appendix auriculæ. 25. The sinus of the right auricle. 26. The superior vena cava, divided near its entrance into the right auricle. 27. Part of the ascending aorta. 28. The trunk of the pulmonary artery. 29. The right pulmonary artery. 30. The left pulmonary artery. 31. Part of the ligamentous cord of the ductus arteriosus. 32, 32. Pulmonary veins. 33. The right bronchus, cut short just as it is entering the lung above and rather behind the right pulmonary artery. 34. The left bronchus, descending behind the left pulmonary artery to enter the lung beneath that trunk. The vessels 29, 32, 33, on the right side, constitute the root of the right lung; and 30, 32, and 34, the root of the left lung. 35. The trunk of the descending aorta, divided across. 36. The thoracic duct. 37. The section of the œsophagus. 38. Divisions of the left pneumogastric nerve. 39. The right pneumogastric nerve. 40. The divided cylinder of the vena azygos. The structures from No. 35 to 40 are situated within the posterior mediastinum.

Fig. 2. A minute portion of the human lung, magnified fifty diameters: copied from Bourgery's plates. This figure shows the capillary net-work formed by the ultimate ramifications of the pulmonary artery and veins.

Nos. 1, 1. The arterial side of the figure. 2. A large branch of the pulmonary artery supplying the plexus with blood. 3. A venous trunk conveying the blood from the capillary plexus.

Fig. 3. A portion of the lung; showing the distribution of the nervous filaments of the pulmonary plexuses around the vessels and bronchial tubes.—After Reisseisen.

No. 1. The pulmonary vein. 2. The pulmonary artery. 3, 3. The bronchial tube. The nervous filaments are seen ramifying upon these vessels.

Plate 16.

Fig. 1.

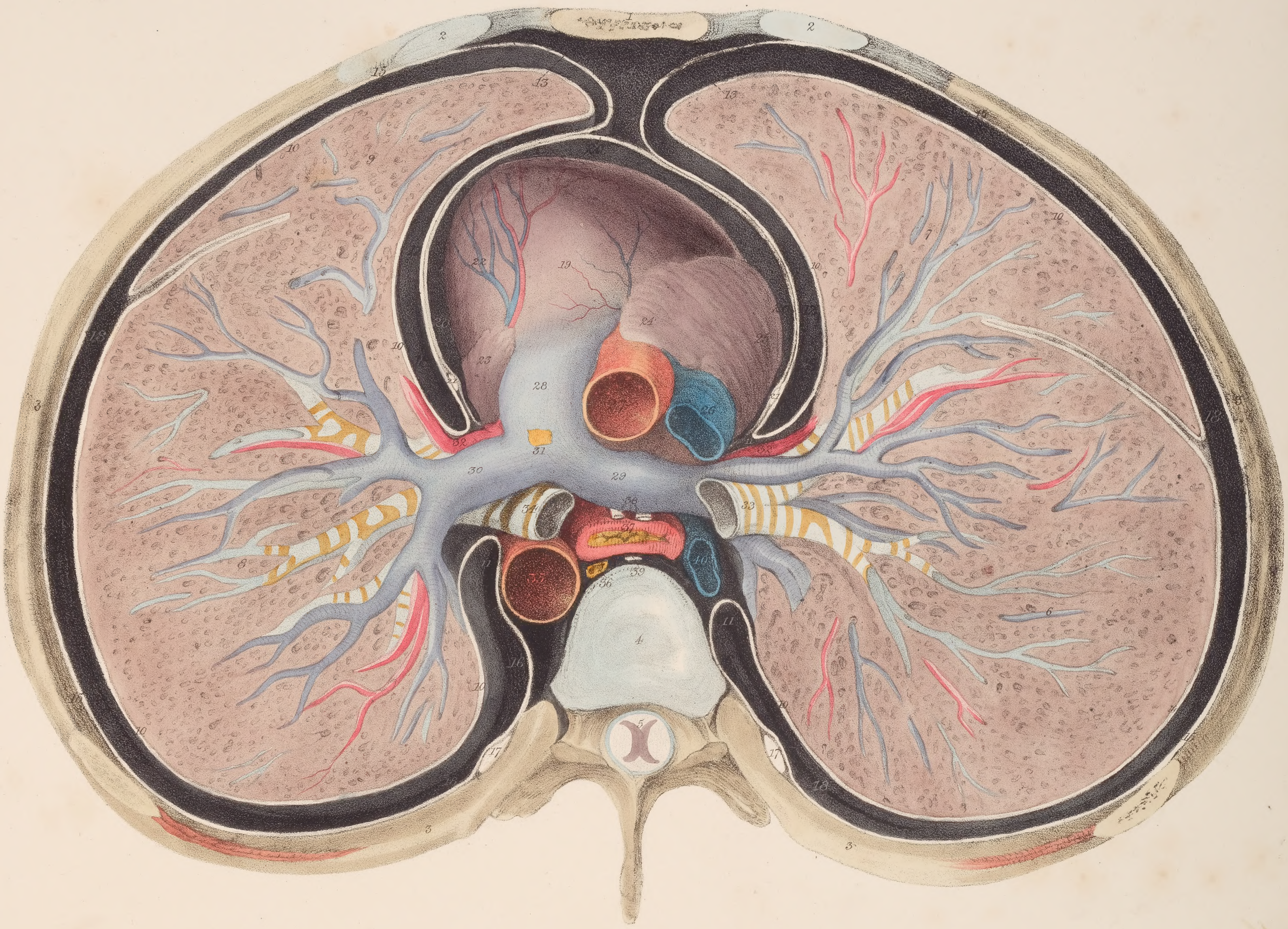

Fig. 2.

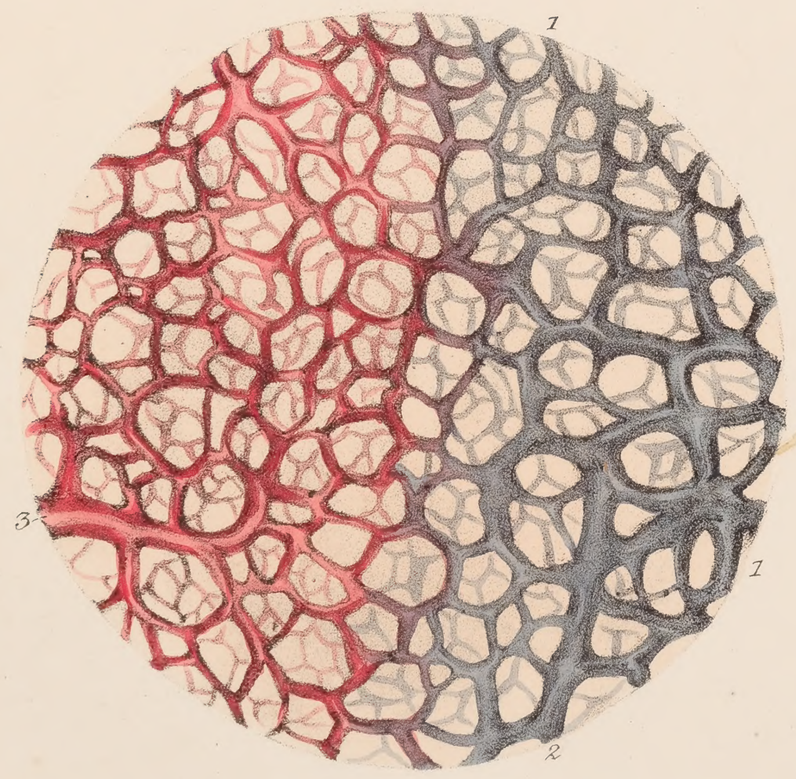

Fig. 3.

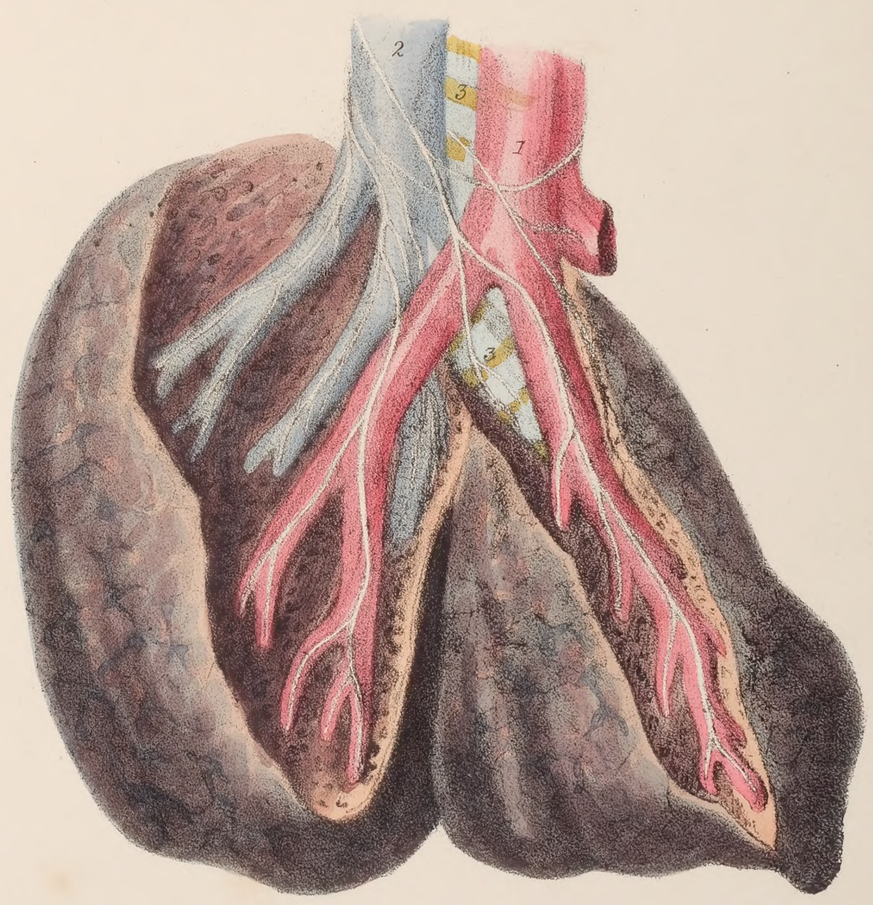

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Plate 17.

Fig. 1.

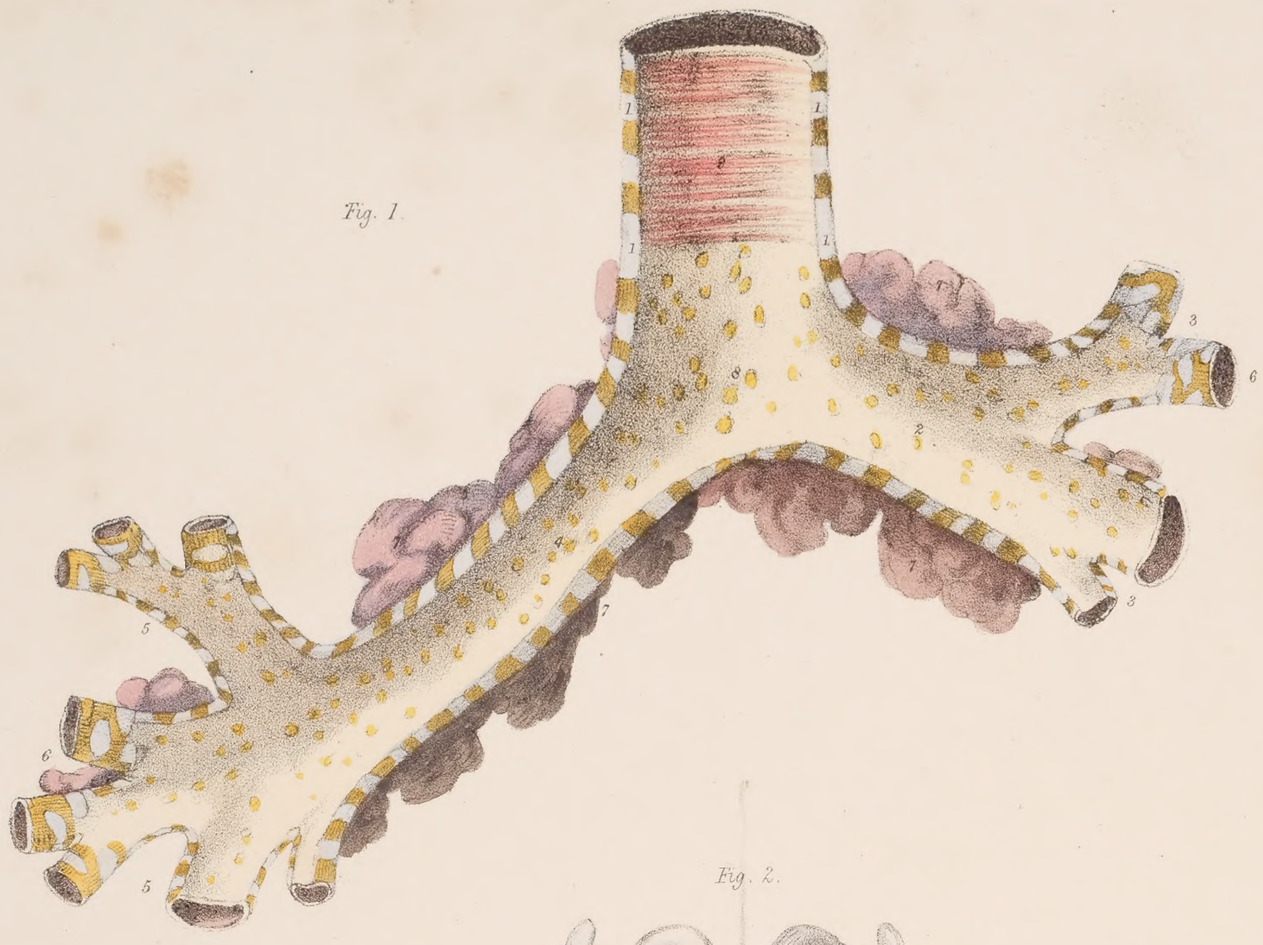


Fig. 2.

Fig. 3.

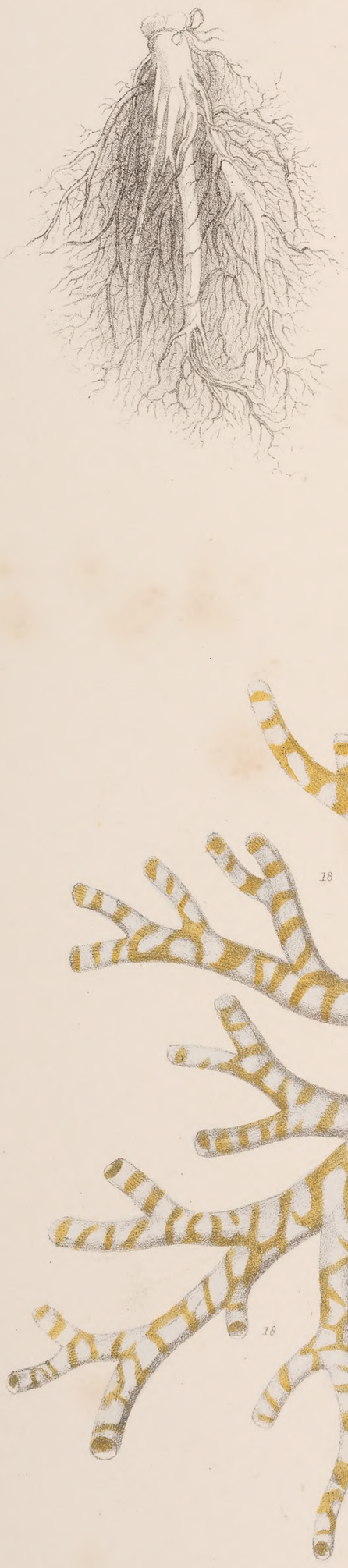


Fig. 4.

Fig. 5.

from one another, being attached all round the circumference of the opening, whilst in the rest of their extent they lie within the cavity of the ventricle. One of them rests upon the septum, or corresponds with it; another with the anterior wall of the cavity; whilst the third or larger is inclined obliquely upwards, and, as it were, interposed between the auricular and pulmonary apertures. The free margin of each is a little thickened, and gives attachment to the chordæ tendineæ.

The *left auricle* (sinus pulmonalis) is situated at the posterior part of the base of the heart, where the greater portion of it is concealed by the pulmonary artery and the aorta, which overlap it, the auricula alone being visible, without detaching these vessels, or inverting the position of the heart. When distended, it is of a square form, and into its angles open the pulmonary veins, those of the left lung being very close together. From its upper and left extremity projects the auricula, which is narrower, but longer and more tapering than that of the right side. Its margins are more deeply dentated, and present some angular inflections or zigzags. Its point rests on the root of the pulmonary artery. The interior of the left auricula presents musculi pectinati similar to those in the right, but the general cavity of the auricle is smooth. A slight depression may be observed in the septum auricularum, corresponding with the fossa ovalis. In the inferior part of the cavity is situated the *auriculo-ventricular opening*, the circumference of which gives attachment to the mitral valve.

The *left ventricle* (ventriculus aorticus) occupies the left border of the heart, about one-third of its extent appearing on the anterior surface, the rest being placed posteriorly, owing to the obliquity of the septum ventriculorum. Its cavity can be conveniently exposed by making two incisions through its wall parallel with the septum, and uniting at an angle near the apex. When the flap thus formed is drawn upwards, the great thickness of the walls of the cavity, as compared with those of the right ventricle, is rendered manifest. The columnæ carneæ resemble those of the right side, but are thicker, and directed for the most part from the base to the apex of the heart. Their intersections are exceedingly numerous at the summit of the cavity, and along its posterior wall, but the upper part of the anterior one is comparatively smooth. Two fleshy fasciculi of considerable size, commencing by smaller bundles, one from the anterior, the other from the posterior surface, pass upwards and terminate each in a blunted extremity, from which numerous chordæ tendineæ branch off to be inserted into the edges of the mitral valve. The auriculo-ventricular opening is guarded by a valve, similar in structure to that of the right side, but differing from it in presenting but two

PLATE XVII.

The anatomy of the trachea and bronchial tubes.

Fig. 1. The posterior part of the trachea at the point of its bifurcation into the two bronchi.

Nos. 1, 1. The extremities of the semilunar fibro-cartilages of the trachea. 2. The right bronchus, larger than the left, and passing off from the extremity of the trachea at a right angle. 3. The subdivision of the right bronchus into bronchial tubes. 4. The left bronchus, longer and narrower than the right, and more oblique in its direction. 5, 5. The bronchial tubes into which the bronchus is dividing. 6, 6. Bronchial tubes upon which the irregular plates and patches of fibro-cartilage are seen surrounding the entire cylinder. 7, 7. Bronchial glands, situated in considerable number upon the trunks of the two bronchi, and upon the lower extremity of the trachea. 8. The fibro-cellular membrane which completes the posterior part of the trachea and bronchi; the granulations situated upon this membrane are the tracheal glands. 9. The muscular layer of the trachea; this layer is brought into view by turning down the cellulo-fibrous membrane.

Fig. 2. The larynx and trachea, with the ramifications of the bronchial tubes.

No. 1. The thyroid cartilage. 2. The projection called pomum Adami. 3, 3. The alæ of the thyroid cartilage. 4, 4. The oblique line upon each ala. 5, 5. The superior cornua of the cartilage. 6, 6. Its inferior cornua. 7. The crico-thyroidean membrane. 8. The cricoid cartilage. 9, 9. The fibro-cartilaginous rings of the trachea. 10. One of these rings, having a peculiar form, and several communications with adjoining rings. 11. A communicating band passing obliquely between two rings. 12. A bifurcating ring. 13. A double bifurcating ring. 14. The last tracheal ring, which always presents an angular pointed process inferiorly. 15. The elastic tissue connecting the cricoid cartilage with the first tracheal ring. 16, 16. The elastic tissue connecting the other tracheal rings together. 17. The right bronchus. 18, 18. Bifurcations of the right bronchus, upon which the fibro-cartilage is distributed in irregular plates. 19. The left bronchus. 20, 20. Bronchial tubes given off from the left bronchus, and exhibiting the same irregular patches of fibro-cartilage which are seen on the right side.

Fig. 3. Minute subdivisions of a bronchial tube.—After Ruysch.

Fig. 4. A small portion of lung considerably magnified; the terminal bronchial tubes are filled with mercury, and are seen to end in small vesicular dilatations, the air-cells.—After Cloquet.

Fig. 5. Horizontal section of a single ring of the trachea, showing its curve, and the extent of the membranous layer which connects the extremities of the fibro-cartilage posteriorly.

pointed processes; hence it has been termed the *mitral valve* (*valvula mitralis*). The larger division of it looks towards the aortic opening. To the right side of and before the large opening just noticed, is situated a smaller one, which communicates with the aorta, and is guarded by three valvular folds of the lining membrane, similar in structure and form to those of the pulmonary artery, and also called *sigmoid* or *semi-lunar valves*. In one instance we saw four semi-lunar valves, in another there were but two.

Structure.—The heart is covered by the serous layer of the pericardium, which is reflected upon it, and lined in its interior by a membrane of apparently similar structure, which not only serves as a coating for its proper substance, but also forms folds or valves at the auriculo-ventricular openings at each side, as well as the semi-lunar valves, where it is prolonged into the aorta and the pulmonary artery. Between the investing and the lining membrane is placed the proper muscular tissue of the organ. The muscular fibres of which the parietes of the heart are made up, differ not only in their quantity and number in each of its cavities, but also in their mode of arrangement. The smoothness of the heart's surface is obviously owing to the membrane which invests it. Within the cavities of the ventricles, and in the auricular appendages, we can readily see how the muscular fibres are disposed and interlaced, without disturbing the lining membrane; but to expose those on the outer surface, the investing membrane must be taken off. When this is carefully done, it will be found that the fibres of the ventricles run obliquely from above downwards to the left, and backwards, which disposition of them can be demonstrated even to the apex. M. Gerdy has shown that the fibres also form curves, whose convexity is turned forwards towards the apex; for if any given fibre commences at the surface, it will be found to dip in so as to become deeply seated at its termination, and *vice versâ*, by which means the bend of their curves will be turned as above stated. Owing to this disposition, the fibres of one ventricle are not all continued across into the other; many of them are seen to turn inwards at the septum, and mix with its substance. By following the course of these, we can separate the septum into two planes; but the greater part of its substance appears to belong to the left ventricle. The external stratum of fibres extends over the whole surface of the ventricles; within these is another plane (not, however, so extensive, as it does not reach much more than halfway to the apex), whose fibres take a different direction, so as to decussate with those of the outer layer; and, lastly, a third plane at the inner surface of the ventricles runs longitudinally from below upwards to the base, being continuous with the columnæ carneæ; but towards the apex they run in every possible direction, rendering the surface minutely reticulated.

But, it will be asked, have these fibres any common point of departure—an origin, as it is usually called? They will be found to commence at the base of each ventricle, deeply in the groove which separates it from the auricle. The examination of them is facilitated by filling all the cavities with plaster of Paris, and immersing the heart in boiling water for an hour or two; the serous pericardium can then be easily removed, and the muscular fibres traced deeply into the groove, where they will be found attached to a white tendinous, or rather cellulo-fibrous band of fibres. A fasciculus of this sort occupies the grooves at the anterior and posterior aspect, corresponding with the auriculo-ventricular openings; but it does not reach round their circumference; it seldom extends more than halfway. The two pair of fasciculi thus disposed are connected with a fibrous structure placed at the aortic aperture, at each side of which are two tendinous points, connected by a transverse band passing round the posterior segment of the aperture. To this band the fibrous fasciculi in the posterior grooves are attached, whilst the anterior pair are connected with the tendinous points. Taken altogether, this structure may be called apparatus tendinosus cordis. M. Gerdy* names it "tissu albuginé cardiaque," and Wolff "textus cartilagineus cordis." The muscular fibres of the auricles are thin, and in a manner scattered; most of those in the sinuses are transverse, but posteriorly, at the junction of the venæ cavæ in the right auricle, some run longitudinally; and higher up, at the orifice of the superior cava, they become circular, and seem as if prolonged a little way upon it.

During the progress of *post-mortem* examinations, it often becomes a question whether the heart of the subject is of its natural size—its walls of their proper thickness—its cavities of their normal capacity—or, in other words, does simple hypertrophy exist, or hypertrophy with dilatation, or the concentric hypertrophy described by Bertin?† Laennec has stated,‡ as the result of his observations, that the heart in its natural condition is about the same size as the closed hand of the individual. This cannot be considered a good standard of comparison, for no part of the body is so liable to be influenced by accidental circumstances as the hand. We must then resort to weight and measure to determine the

* Mémoire sur l'Organisation du Cœur.—*Journal Comp. du Dict. des Sciences Médicales.*

† Traité des Maladies du Cœur. ‡ Traité de l'Auscultation Mediate, vol. ii.

point. Its weight is about ten ounces,* its length from the apex to the middle of the auricles averages five inches and a half, of which four appertain to the ventricles; the breadth of the ventricles is three inches at their base, and that of the auricles three and a half. The thickness of the walls of the left ventricle is a little more than double that of the right. Now, the anterior wall of the left ventricle is five or six lines in thickness at the base, but scarcely three towards the apex. The thickness of the septum at its middle is about four lines. The results of measurement made by different persons to determine the capacity of these cavities are so various, that nothing positive can be stated upon it.

Vessels and nerves.—The heart receives its blood by the two coronary arteries; its veins terminate in the right auricle; its nerves come from the cardiac plexus, and appear very small as compared with the bulk and quantity of matter of the organ; a circumstance which was much insisted on in the discussion of the long-litigated question—Do the fibres of the heart possess their susceptibility to impression (irritability) *per se*, or do they derive it from the nerves?

We may, in concluding these remarks, observe, that those deviations from the normal condition of the heart which are congenital, and are ordinarily termed malformations, are referable to the general law which we indicated when treating of varieties in the distribution of arteries; for in many instances they are found to be but repetitions of some of the fixed modes of conformation in inferior animals, most commonly that of reptiles. The degrees of deviation in different instances are various. In some the organ is altogether rudimentary, being "a mere expanded vascular trunk. To these follow the heart, with a very imperfect muscular structure, containing a single valveless cavity, with a very imperfect trace of an auricle; then such hearts as are occasionally formed with but a single ventricle and auricle, with a corresponding vascular trunk; succeeded by those which, having merely a single ventricle, are furnished with an auricle more or less perfectly divided by a partition into two cavities, whence the venous and arterial trunks simultaneously arise, either confounded together or distinctly divided. More perfect and more common are those formations of the heart in which, either by the increased capacity of the ventricles, or by the gradual developement of the partition, merely open at a single point, the division into two ventricles is effected, of which sometimes the right, sometimes the left, is imperfect. Lastly, we meet with hearts which depart from the normal structure merely so far as that the fœtal blood-passages remain open, the oval hole, or the ductus arteriosus, (one or both,) remaining unclosed."†

The Lungs.—The lungs (plates XIV. XV. XVI.; *pulmones*) constitute the organ of respiration, and are two in number; they occupy the lateral parts of the cavity of the thorax, which they completely fill. Each lung is of a conical figure, and rests upon the diaphragm, whilst its summit extends a little above the first rib. The external surface of the lung, smooth and convex in its general outline, corresponds with the arch of the ribs; the internal is compressed, and rests against the mediastinum, and at its middle third the bronchi and vessels enter its substance, forming, by their aggregate, what is called the *root* of the lung. The anterior border is thin and sharp, whilst the posterior is rounded and prominent, being received into the groove formed between the vertebral column and the ribs. The base, surrounded by a sharp border, is concave, and rests on the arch of the diaphragm; whilst the summit is tapering and rounded, where it ascends between the scaleni muscles. Each lung is divided into lobes by a deep fissure, whose direction is from above downwards, and from behind forwards; the lower lobe of each is thus quadrilateral in its figure, the upper conical. The perpendicular depth of the left lung is greater than that of the right, as the corresponding part of the diaphragm does not ascend so high; its inner border is also excavated to receive the pericardium and heart. The left lung has two lobes, divided, as has been above stated; the right presents three, the third being intermediate in size and situation between the two others. It appears like an angular piece, detached by a groove from the anterior and inferior part of the upper lobe.

Each lung is invested by a serous lamella, derived from the pleura; its interior is lined by a prolongation of mucous membrane, and the intervening structures form, by their aggregate, what is called the parenchyma of the organ.

The Pleura.—There are two membranes named *pleura* (plates XIV. XVI.) each being thin, semi-transparent, and so disposed as to form a shut sac, thus conforming to the general law of serous membranes. Each membrane will thus be found to line the inner surface of the thoracic parietes, and to be reflected over the corresponding lung, giving it a smooth investment, the point of reflection corresponding with the root of the organ. Inferiorly, the membrane covers the convex surface of the diaphragm, and superiorly forms a small cul-de-sac at the bottom of the neck, over the summit of the lung. The part of the membrane which invests the lung is called *pleura pulmonalis* — that which lines

* Meckel, vol. ii. p. 252 et seq.

† Otto's Compendium of Pathological Anatomy, translated by J. F. South.

the thorax, *pleura costalis;* it would be more correct to say, "pars pulmonalis," and "pars costalis." These two membranous sacs, by their apposition along the middle line, form a partition (*mediastinum*), which divides the thorax into its two lateral chambers; it extends from the top of the thorax to the diaphragm, and from the spine to the sternum, with some inclination to the left side (inferiorly), owing to the position of the pericardium and heart. The interval between the two membranes in this situation gives lodgement, immediately behind the sternum, to the thymus gland and some cellular tissue; and lower down to the pericardium and heart. Along the spine we find, similarly situated with regard to the membranes, the œsophagus, the vagus nerves, the descending aorta, thoracic duct, vena azygos, and splanchnic nerves, with some lymphatic glands and cellular tissue. Now the bronchi and root of the lungs, by their transverse position, separate the mediastinal interstice into two parts, of which one is termed, ordinarily, the *anterior,* and the other the *posterior mediastinum.*

Structure.—The anatomical constituents of each lung are: 1. The bronchus and its ramifications. 2. The pulmonary artery and pulmonary veins. 3. Bronchial arteries and veins. 4. Lymphatics. 5. Nerves of the pulmonary plexus. These are enclosed in a quantity of cellular tissue, which forms a connecting medium between them.

The Trachea and Bronchi.—The description of the bronchus considered as a constituent of the lung, includes that of the trachea, or rather presupposes a knowledge of it.

The *Trachea* (plate XVII. fig. 2; τραχεια αρτηρια, aspera arteria) is a cylindrical tube, which

PLATE XVIII.

The anatomy of the heart.

Fig. 1. The anterior surface of the heart brought into view by dividing and drawing aside the pericardium. It occupies its natural position in the chest, resting, by its under side, upon the central tendon of the diaphragm.

Nos. 1, 1. The pericardium, drawn to either side by hooks. 2, 2. The attachment of the fibrous layer of the pericardium to the external coat of the aorta and the great vessels of the root of the heart. 3, 3. The diaphragm, to which the fibrous layer of the pericardium is attached inferiorly. 4, 4. The fibrous surface of the pericardium; the figures 1, 1 are situated upon the serous surface. 5. The trunk of the superior vena cava. 6. The inferior vena cava, emerging from the opening in the diaphragm to enter the right auricle. 7. The sinus of the right auricle. 8. Its appendix. 9. The right ventricle. 10. Its sharp border. 11. The infundibuliform portion, which corresponds with the sinus of the pulmonary artery. 12. Branches of the right coronary artery and anterior cardiac vein. 13. The left coronary artery and great cardiac vein with their ramifications, in the anterior ventricular groove. 14. The left ventricle, forming the apex of the heart. 15. The left auricle. 16. Its auricular appendage. 17. The pulmonary artery. 18. The ascending aorta. 19. The arch of the aorta. 20. The trunk of the arteria innominata. 21. The left carotid artery. 22. The left subclavian artery. 23. The descending aorta.

Fig. 2. The anterior surface of the heart; showing the distribution of the coronary vessels, the pericardium having been removed.

No. 1. The trunk of the superior vena cava. 2. The sinus of the right auricle. 3. The appendix auriculæ. 4. The inferior vena cava. 5. The right auriculo-ventricular groove, in which the right coronary vessels are situated. 6. The right ventricle. 7. A large branch of the right coronary artery, accompanied by the ramifications of the anterior cardiac vein. 8, 8. Two small branches distributed to the right auricle. 9. The pulmonary artery. 10. The left appendix auriculæ. 11. The left coronary artery, descending along the anterior ventricular groove to the apex of the heart, and accompanied by the ramifications of the great cardiac vein. 12. The left ventricle. 13. The ascending aorta. 14. The arch of the aorta. 15. The trunk of the arteria innominata. 16. The left carotid artery. 17. The left subclavian artery. 18. The commencement of the descending aorta. 19. One of the left pulmonary veins.

Fig. 3. The posterior surface of the same heart; showing the distribution of vessels upon this aspect.

No. 1. The trunk of the superior vena cava. 2. The opening of the inferior vena cava. 3. The posterior aspect of the right auricle. 4. The right ventricle. 5. The opening of the coronary vein into the right auricle. 6. A large trunk receiving the blood from the anterior cardiac veins. 7. The trunk of the great cardiac vein. 8, 8. The left cardiac veins. 9, 9. The posterior cardiac veins, joining the great cardiac vein. 10. The right coronary artery, winding around the right auriculo-ventricular groove. 11. The same artery, descending the posterior ventricular groove. 12. A small portion of the posterior branch of the left coronary artery, winding along the left auriculo-ventricular groove to join the right coronary; the rest of the artery is concealed by the trunk of the great coronary vein. 13, 13. Small twigs from this portion of the left coronary artery. 14. The left ventricle. 15. The left auricle. 16, 16. The right pulmonary veins. 17, 17. The left pulmonary veins; the superior one is cut off close to the auricle. 18. The right pulmonary artery. 19. The trunk of the pulmonary artery at its bifurcation. 20, 20. The left pulmonary artery. 21. The fibrous cord resulting from the obliteration of the ductus arteriosus of the fœtus. 22. The arch of the aorta. 23. The trunk of the arteria innominata. 24. The left carotid artery. 25. The left subclavian artery.

Plate 18.

Fig. 1.

Fig. 2.

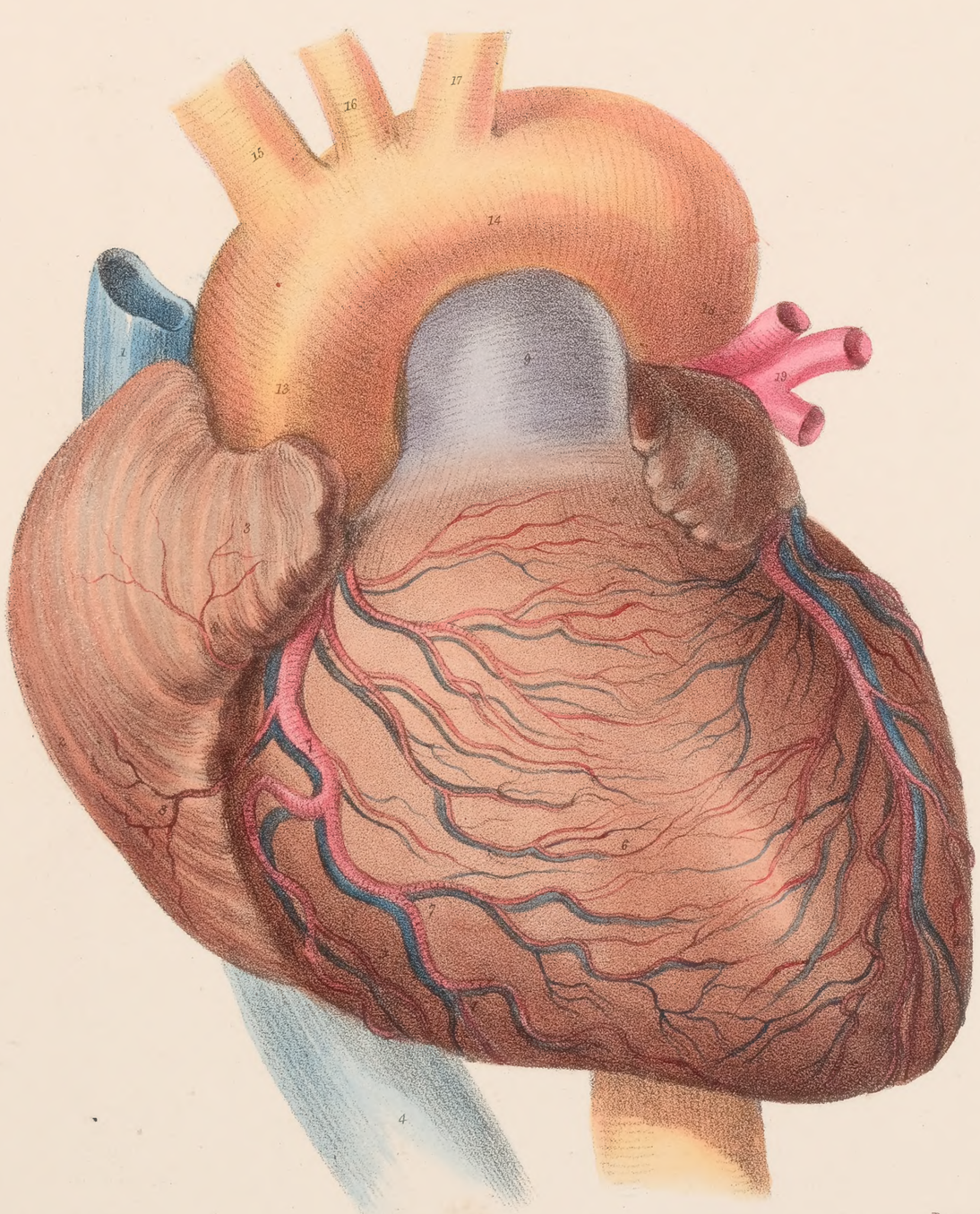
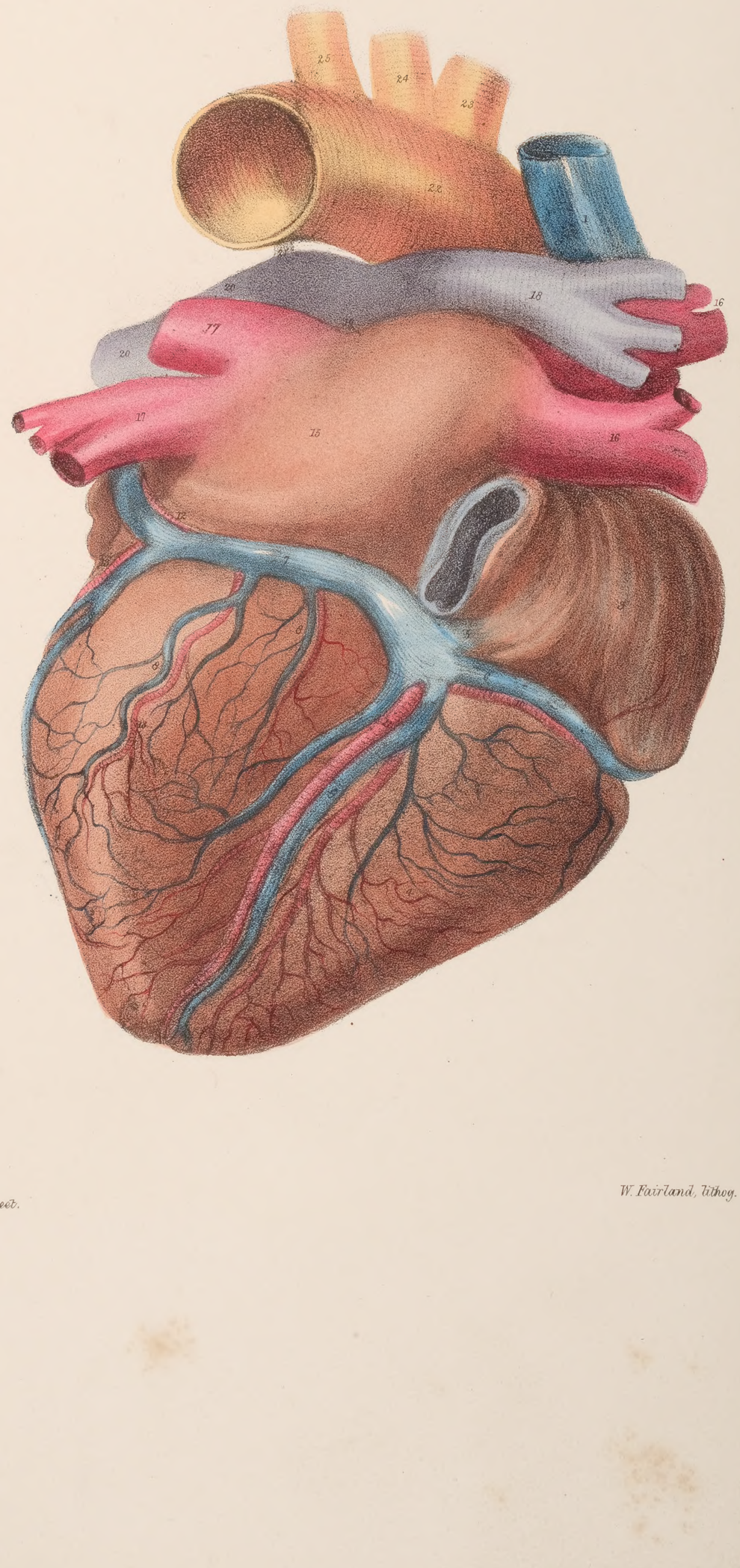


Fig. 2.



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W. Fairland, lithog.

Plate 19.

Fig. 1.

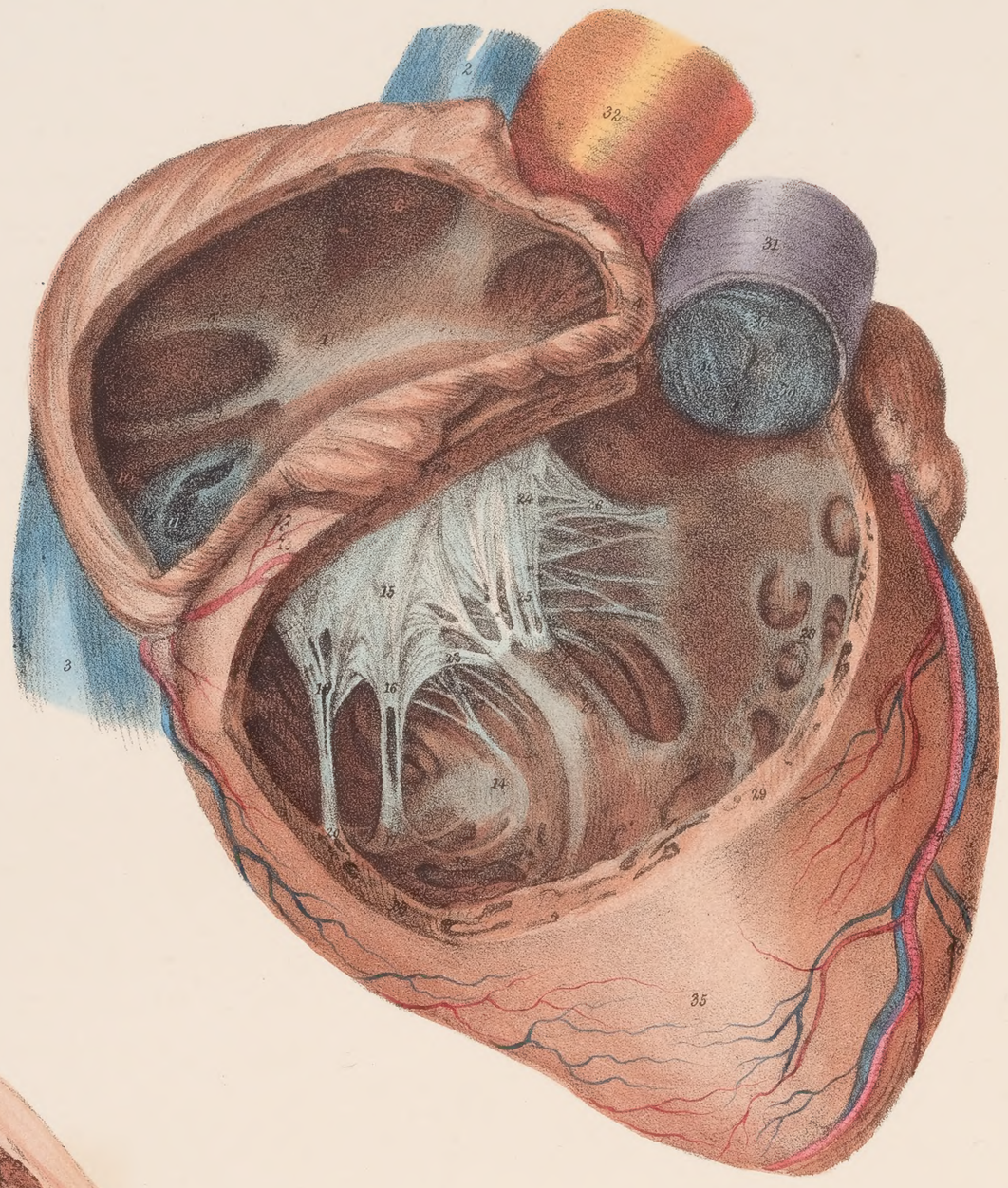


Fig. 3.

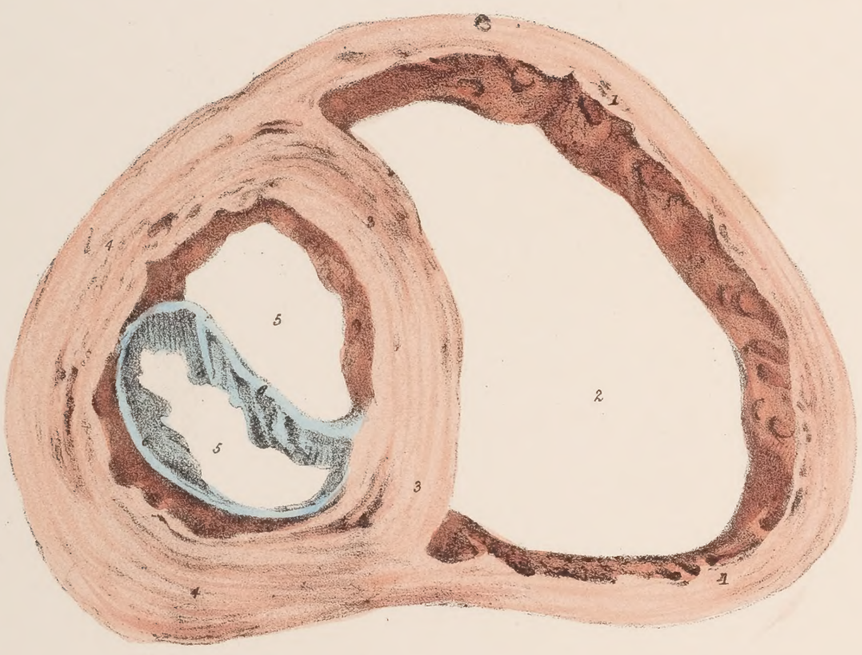


Fig. 4.

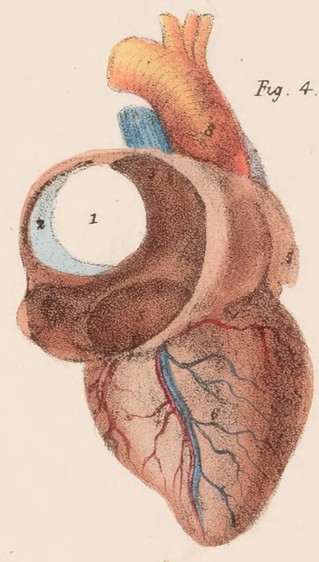


Fig. 2.

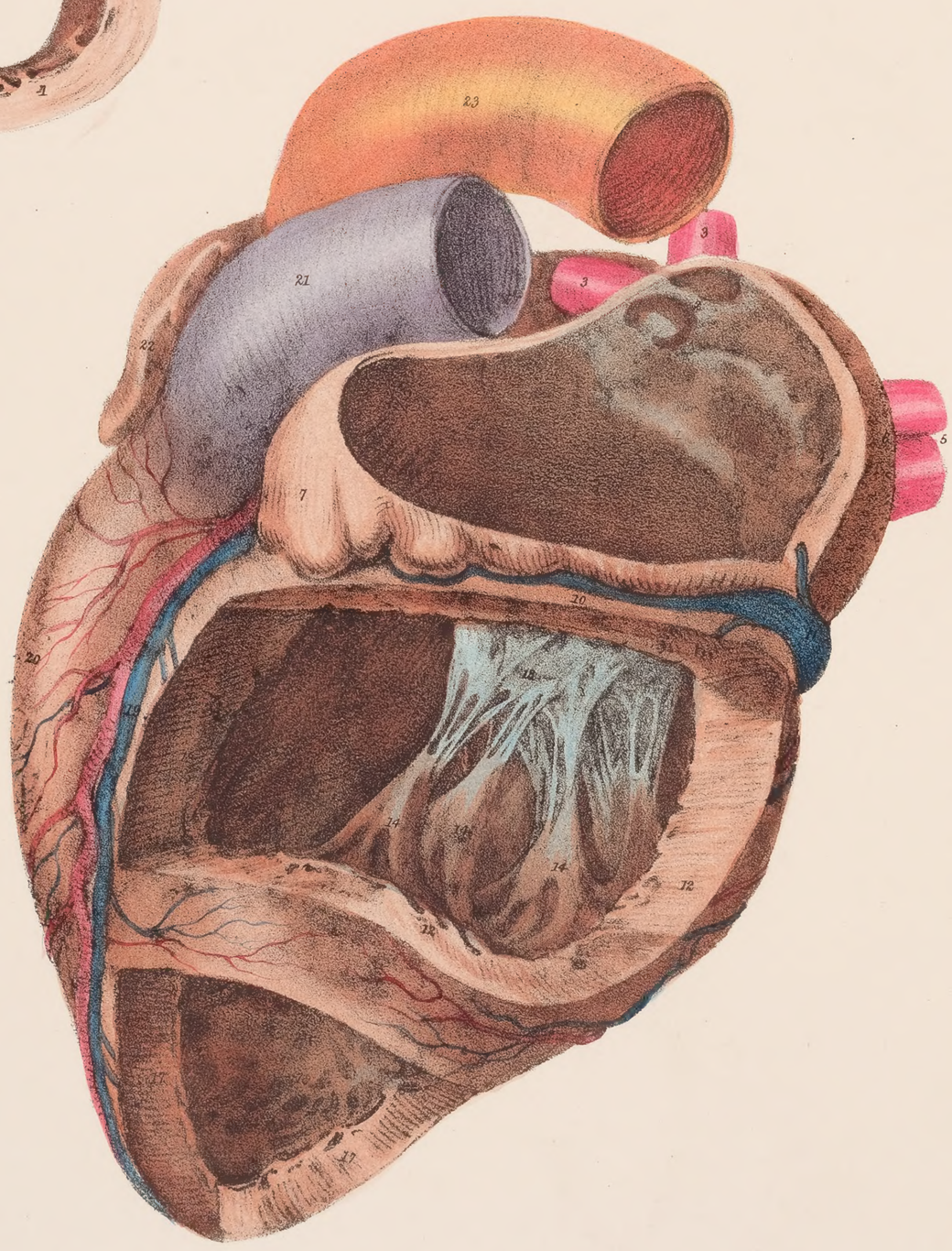
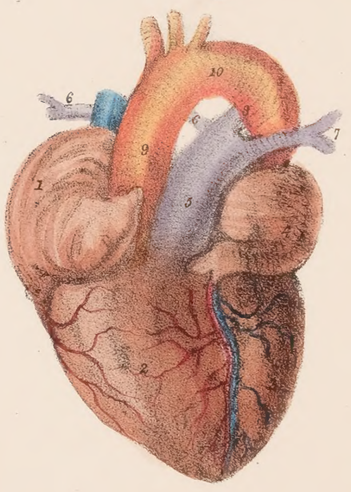


Fig. 5.



W. J. F. Wilson. del. et lith.

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W. Fairland. lithog.

extends from the cricoid cartilage to the third dorsal vertebra, where its division into the bronchi takes place. It rests on the œsophagus, which, however, inclines somewhat to its left side. It is enclosed between the great vessels of the neck, and covered partly by the thyroid gland and its veins, also by the sterno-hyoid and sterno-thyroid muscles, and crossed by the brachio-cephalic artery, the left brachio-cephalic vein, and the arch of the aorta. The bronchi, commencing at the bifurcation of the trachea, incline laterally towards the lungs; the right one, larger but shorter than the other, inclines outwards, almost horizontally, and enters the lung on a level with the fourth dorsal vertebra; it is enclosed by the termination of the vena azygos, which hooks round it, and by the arch formed by the right pulmonary artery. The left bronchus, less in diameter, but longer than the right, inclines obliquely downwards and outwards to reach the lung. The arch of the aorta hooks round it, and the left pulmonary artery lies upon its superior and anterior border. Each bronchus, at its entrance into

PLATE XIX.

The internal cavities of the heart, with the peculiarities of the fœtal heart.

Fig. 1. The right side of the heart; the parietes of the right auricle and ventricle have been removed in order to show their interior.

No. 1. The sinus of the right auricle. 2. The superior vena cava. 3. The inferior vena cava. 4. The appendix auriculæ. 5. The musculi pectinati, seen in the appendix. 6. The opening of the superior vena cava. 7. The septum auricularum. 8, 8. The annulus ovalis. 9. The fossa ovalis. 10. The opening of entrance of the inferior vena cava. 11. The opening of the coronary vein. 12. The coronary valve. 13. The auriculo-ventricular groove. 14. The cavity of the right ventricle. 15. The right segment, or "curtain" of the tricuspid valve. 16. Chordæ tendineæ of the right valve, inserted into, 17, the right columna papillaris (columna carnea). 18. A small moderator band. 19. Chordæ tendineæ of the right valve, inserted into the third and smallest columna papillaris, 20. 21. The long columna papillaris, attached by its base to the right wall of the ventricle. 22. The "long moderator band."* 23. Chordæ tendineæ of the right segment of the tricuspid valve, inserted into the apex of the long columna papillaris. 24. The anterior segment, or "curtain," of the tricuspid valve, situated between the auriculo-ventricular opening and that of the pulmonary artery. 25. Chordæ tendineæ of this valve, inserted into the apex of the long columna papillaris. 26. Other chordæ tendineæ of the anterior valve, inserted into the septum ventriculorum. 27, 27. Chordæ tendineæ of the third segment or valve, the "fixed curtain." 28. Columnæ carneæ. 29, 29. The cut edge of the section of the right ventricle. 30, 30. The three semilunar valves of the pulmonary artery. 31. The pulmonary artery. 32. The ascending aorta. 33. The left appendix auriculæ. 34. The anterior coronary vessels, taking their course along the anterior ventricular groove. 35. The external surface of the right ventricle. 36. The left ventricle.

Fig. 2. The left side of the heart: the cavities are exhibited by removing a part of their external wall.

No. 1. The cavity of the left auricle. 2. The entrance of the two right pulmonary veins, 3, 3. 4. The entrance of the two left pulmonary veins, 5. 6. The external surface of the sinus of the auricle. 7. The appendix auriculæ. 8. Musculi pectinati in the appendix auriculæ. 9. The auriculo-ventricular opening. 10. The auriculo-ventricular groove. 11. The great cardiac vein. 12, 12. The cut edge of the section of the outer wall of the ventricle. 13. One segment of the mitral valve, attached by chordæ tendineæ to three columnæ papillares (columnæ carneæ), 14, 14. 15. Chordæ tendineæ of the opposite valve attached to other columnæ papillares (columnæ carneæ). 16. The sinus of the ventricle, leading upwards to the opening of the aorta; some carneæ columnæ are seen upon this wall of the ventricle below the figures. 17, 17. The cut edges of a section of the apex of the left ventricle. 18. Columnæ carneæ. 19. The anterior coronary vessels, ramifying in the anterior coronary groove. 20. The right ventricle. 21. The pulmonary artery. 22. The appendix of the right ventricle. 23. The commencement of the arch of the aorta.

Fig. 3. A horizontal section made through the ventricles of the heart near to their base, showing the relative dimensions of the walls of the two cavities.

Nos. 1, 1. The wall of the right ventricle. 2. The area of its cavity. 3, 3. The septum ventriculorum. 4, 4. The wall of the left ventricle. 5, 5. The area of its cavity. 6, 6. Part of the mitral valve; the free segment of the valve appears to divide the area into two nearly equal portions.

Fig. 4. The fœtal heart at about the eighth month, showing the foramen ovale, widely distended.—From a dried specimen in the collection of the Editors, prepared by inflation.

No. 1. The foramen ovale. 2. The incipient septum ovale, forming a thin falciform projection upon the posterior wall of the auricles. 3. The entrance of the superior vena cava into the right auricle. 4. The opening of the coronary vein. 5. The auriculo-ventricular opening. 6. The right ventricle. 7. The appendix of the right auricle. 8. The aorta.

Fig. 5. A front view of the same heart.

No. 1. The right auricle. 2. The right ventricle. 3. The left ventricle. 4. The left auricle. 5. The pulmonary artery. 6, 6. Its right branch. 7. Its left branch. 8. The ductus arteriosus. 9. The ascending aorta. 10. The arch of the aorta giving off its three branches.

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* Essay on the Safety-valve function in the Right Ventricle of the Human Heart, by T. W. King.—*Guy's Hospital Reports*, vol. ii.

the lung, divides into two branches, one being intended for each lobe. The lower branch of the right lobe also subdivides, or rather gives off a branch to its middle lobe. Each bronchial ramification in its course gives off tubes of smaller size; and so, by a process of division and subdivision continued through five or six successive stages of decrease, a series of tubes is formed, increasing in number as they decrease in size, until, finally, each becoming capillary, terminates in a minute cul-de-sac or air-vesicle, the aggregate of which constitutes the proper cellular structure of the lungs.

Structure of the Trachea.—This tube is composed of fibro-cartilaginous rings, varying from sixteen to twenty in number, and of membranes which connect them. The rings do not extend all round the tube; they exist at the front and sides, but are deficient posteriorly. A thin, yet elastic, fibrous lamella forms the circumference of the tubes, serving to connect the cartilaginous rings, which seem as if developed in its interior, and also to complete the circuit posteriorly where these rings are deficient. Interiorly to these is situated the mucous lining, continuous superiorly with that of the larynx, and prolonged throughout the whole of the bronchial ramifications. Where the cartilaginous rings are deficient, the mucous membrane is supported by some longitudinal fibres, and beneath it we also find a series of muscular fibres resembling those of the intestinal canal. These are disposed transversely, so as to connect the extremities of the cartilaginous rings.

The bronchi and their primary ramifications are made up of the same constituents as the trachea; but the rings are found gradually to lose their annular form, and to degenerate into lamellæ of irregular shape, placed in different parts of the circumference of the canal. At the several points of subdivision, however, they are still somewhat annular, so as to keep their orifices open. The rings thus gradually disappear, so that at the ultimate divisions of the bronchi they no longer exist, nor are they required, for the air which distends the vesicles is never altogether excluded from them. So far as the bronchi are cognizable by our senses, they appear to consist of materials analogous to those found in the larger tubes, but gradually reduced to the greatest degree of tenuity. If they be injected with quicksilver, the globular form of the vesicles, and the cylindrical form of the ultimate ramusculi which terminate in them, are rendered manifest; and as the mucous membrane is prolonged into the vesicles forming their lining, it is a legitimate matter of inference, from the various facts disclosed by the general anatomy of tissues, that the fibrous lamellæ and muscular structure extend to them also. In support of this inference it may be urged, that if the lungs were simply passive, and therefore incapable of contributing to the expulsion of the air, the subsidence of the thorax upon them would only press the air out of the parts near their surface, but could exert little influence over those which are deeper seated. Besides, if one side of the thorax of a living animal be opened, the degree in which the lung becomes diminished is greater than that which is ordinarily produced by the weight of the atmosphere. This indicates a contractile, and even an irritable power in the organ.

Pulmonary artery.—The pulmonary artery (plate XV. fig. 1, Nos. 13, 14, 15; plate XVI. fig. 1, Nos, 28, 29, 30: *arteria pulmonalis, vena arteriosa*) arises from the base of the right ventricle of the heart, from which it proceeds upwards and a little towards the left side for the space of about two inches, having a slight inclination, at the same time, from before backwards; opposite the concavity of the aortic arch, it bifurcates into its right and left branches. It partially conceals the aorta at its origin, and is connected with it by the serous lamella of the pericardium. At its point of bifurcation it is also connected to the cavity of the arch by the ductus arteriosus in fœtal life, and subsequently by the ligamentous remains of that vessel. The *right* branch, larger and longer than the left, inclines almost transversely towards the corresponding lung, which it reaches after passing behind the ascending aorta and the superior vena cava: it lies upon the right bronchus, but soon makes a turn so as to embrace it; after which it separates into three divisions. The *left* branch passes in front of the descending aorta, immediately beneath its arch, and, after reaching the upper border of the corresponding bronchus, divides into two branches. The primary and each succeeding division of the pulmonary arteries correspond with those of the bronchial tubes, whose course they follow to their final terminations in the air-vesicles, where they become capillary.

Pulmonary veins.—The pulmonary veins (plate XV. fig. 1, Nos. 17, 18; fig. 2, Nos. 5, 6, 7; *venæ pulmonales, arteriæ venosæ*), two in number at each side, commence by minute radicles, which are continuous with the capillary terminations of the arteries. They are found to converge to the root of the lung from different parts of its structure, and in their course increase in size as they diminish in number. The veins of the right lung pass behind the right auricle and the superior vena cava; those of the left have a shorter course to run in order to reach the left auricle, which is their common destination; thus, the pulmonary, or smaller circulation, which commences at the right ventricle, and ends at the left ventricle, is completed.

The *bronchial arteries* arise from the aorta; on reaching the root of the lungs each divides into small branches, which follow the divisions of the bronchi until they become capillary. The veins which return the blood of the bronchial arteries terminate at the right side in the vena azygos, at the left in the superior intercostal. Some of them, also, in their course appear to communicate with branches of the pulmonary veins. Some anatomists have been led to conclude, from a consideration of the size of the lungs, that they could not be dependent on the bronchial arteries alone for their nutrition. A similar idea seems to have been entertained concerning the nerves by Haller, who says, "neque multos nec magnos pulmonis nervos esse." But if we compare not the size, but the quantity of matter of the lungs, with that of any other organ, even of the liver, we shall find no reason to question the sufficiency of the bronchial arteries, or to doubt whether they are as well supplied with nerves as other parts.

The *nerves* of the lung are derived from the pulmonary plexus (anterior and posterior). The nervus vagus contributes much the greater share to the formation of the plexus, assisted by the sympathetic nerve. The branches of both form an inextricable interlacement exterior to the lungs, but are not found to anastomose within their substance. An opinion for some time prevailed, that the gangliac nerves were distributed exclusively to the vessels of the lung, and those of the nervus vagus to the bronchi. But Reiseissen,* after a most minute examination of this, and almost every other question that can be raised concerning the structure of the lungs, has come to the conclusion, that the branches derived from the nerves belong alike to the vessels as to the bronchi, and ramify indiscriminately on both.

The *lymphatics* of the lungs are divisible into two sets; one being superficial, the other deep-seated. The superficial vessels run beneath the pleura, and after ramifying, so as to enclose areolar spaces, terminate in the bronchial glands at the root of the lung. The deep-set take the course of the veins; they enter the bronchial glands, and after having emerged from them again, they pass along the trachea; those of the left side terminating in the thoracic duct, those of the right in the lymphatic trunk of the corresponding side.

The Thymus gland.—The structure of this organ (plates XXII. XXIII.) has been hitherto little known (thymus, à θυμος). The recent researches of Sir Astley Cooper have, however, exhibited every part of it in a perfectly clear point of view, and have thrown much light on the purposes which it appears to serve in the economy. "Perhaps," observes Sir Astley,† "no part of the body is more difficult of investigation than the thymus gland in the human subject. Its small size, the delicacy of its texture, its soft and pulpy nature, which renders it liable to tear under the slightest force, and the numerous small lobes which are combined to form it—all conspire to produce this difficulty, and to render it necessary to call in the aids which injection, hardening, unravelling, and the most careful and repeated dissecting, can furnish." A leading peculiarity of this organ is, that its existence is temporary; it can be distinguished as early as the third month of fœtal life; it increases until birth, but its increase is not equable, being much more rapid during the seventh month than in the fifth or sixth. At birth, its weight is about half an ounce; it increases a little to the end of the first year, when it begins to decrease to the time of puberty, and is not only atrophied, but so far changes, as, "in after-age, to cease to have cavities, becoming a body of very small dimensions."‡

The thymus is narrow and elongated, part being lodged in the thorax (in the mediastinum), close behind the sternum, and part extended upwards into the neck. Its colour is greyish, or rather ash-colour, with a reddish tinge; its consistence very soft; its surface uneven and distinctly lobulated. It is not a single organ; for though it presents two lateral and nearly symmetrical parts, the only difference between them being, that the left is often larger than the right; still, as these parts "are generally separated from each other as regards glandular substance, they may properly be called a right and left thymus gland."§ Sometimes a third thoracic lobe exists, which appears to join together those that are placed laterally, but by careful dissection they admit of being separated. Each lateral part may be said to present a base, a summit, two surfaces, and two borders. The base or broad extremity rests on the upper part of the pericardium, to which it is connected by cellular tissue; for at birth it reaches as low down as opposite the fourth rib. The summit extends as high as the thyroid gland; the anterior surface lies behind the first bone of the sternum and the upper part of the second, the origins of the sterno-hyoidei and sterno-thyroidei muscles interposing; in the neck, the latter muscles cover it. The posterior surface rests, while in the thorax, on the left brachio-cephalic vein, on the convexity of the aortic arch, and the origins of the large vessels (a thin layer of cellular

* De structurâ Pulmonum.
† The Anatomy of the Thymus Gland, by Sir A. Cooper.
‡ Op. cit. p. 19.
§ Op. cit. p. 26.

tissue interposing); in the neck, it rests upon the front and sides of the trachea as far up as the thyroid gland. The inner borders are in apposition one with the other, whilst the external margins are enclosed within the interval between the internal mammary vessels and the layers of the mediastinum, and higher up between the great cervical vessels.

The thymus is surrounded by a layer of cellular tissue, which not only connects it with surrounding parts, but binds together the lateral masses that compose it. When this is removed, "the

PLATE XX.

This plate shows the arrangement of the fibres entering into the structure of the heart, according to the researches of Mr. Searle. The drawings have been made from dissections made by Mr. Searle, and most liberally placed at the disposal of the Editors of this work.

Fig. 1. An anterior view of the ventricles of the heart, showing the oblique course and arrangement of the superficial fibres of these cavities.

No. 1. The fasciculus derived from the deep fibres of the left ventricle, emerging from that cavity at its apex. 2. This fasciculus now becomes superficial, winding around the apex of the left ventricle. 3, 3. The fibres of this fasciculus, very much spread out, and taking an oblique course over the front surface of both ventricles. 4, 4. Small accessory fasciculi of fibres derived from the right surface of the septum ventriculorum, and constituting part of the superficial layer of fibres. 5. The left ventricle. 6. The right ventricle. 7. The convexity corresponding with the ventricular sinus of the pulmonary artery.

Fig. 2. The base of the heart, showing the attachment of the superficial fibres of the ventricles to the fibrous rings of the auriculo-ventricular openings, and of the pulmonary artery and aorta.

No. 1. The opening of the pulmonary artery. 2. The opening of the aorta. 3. The right auriculo-ventricular opening. 4. The left auriculo-ventricular opening. The superficial fibres near their insertion assume almost a vertical direction.

Fig. 3. A dissection of the anterior aspect of the heart, showing the superficial fibres raised and turned back in three flaps, in order to bring into view the middle layer of fibres.

No. 1. The flap raised from off the right ventricle. 2. The flap reflected from off the upper part of the left ventricle. 3. The superficial fibres turned down from the lower third of the left ventricle. 4. These fibres are seen to form a fasciculus, which enters the left ventricle through its apex, and is continuous with the deep fibres of that cavity. 5. The broad and thick band of fibres derived from the left surface of the septum ventriculorum at the posterior ventricular groove, and from the columnæ papillares of the left wall of the ventricle. 6, 6. The anterior ventricular groove; at this groove the band, 5, divides into two bands, short and long. 7, 7. The short band, winding obliquely around the lower third of the anterior surface of the right ventricle to the posterior surface of the heart. 8. The short band, near to its termination, appearing from the posterior surface of the base of the ventricles; its fibres are inserted into the anterior border of the left auriculo-ventricular ring, and into the anterior part of the root of the aorta and pulmonary artery. The long band, given off from the deep surface of the band, 5, at the anterior ventricular groove, passes directly backwards, forming the middle layer of the septum ventriculorum, and emerging at the posterior ventricular groove, winds from right to left around the middle third of the posterior aspect of the left ventricle. 9, 9. The long band appearing on the anterior aspect of the left ventricle. 10, 10. Its continuation upon the anterior surface of the upper half of the right ventricle to the posterior surface of the base of both ventricles.

Fig. 4. The middle layer of the fibres of the ventricles, seen upon the posterior surface of the heart.

No. 1. The right ventricle. 2. The right auriculo-ventricular opening. 3. The left ventricle. 4. The opening of the aorta. 5. The fasciculus of superficial fibres of the heart, escaping from the apex of the left ventricle, and seen to be derived from the deep fibres. 6. The thick layer of fibres which gives origin to the short and long bands; this layer is seen on the anterior aspect of the left ventricle in fig. 3, No. 5. 7, 7. The posterior ventricular groove. 8, 8. The short band of the middle layer of the heart; this band is proceeding from right to left. Its commencement is seen in fig. 3, Nos. 7, 7, and its termination at No. 8. 9, 9. The long band winding from right to left around the base of the ventricles. 10, 10. Its fibres, beginning to twist upon themselves to form the rope which surrounds the brim of the left auriculo-ventricular opening.

Fig. 5. An anterior view of the heart; the middle layer of fibres divided over the right ventricle to show the internal fibres of that cavity.

No. 1. The spiral arrangement of the fibres at the apex of the left ventricle. 2, 2. The short band, divided and turned aside. 3, 3. The continuation of the short band, from the section to the posterior aspect of the heart. 4, 4. The long band, divided and turned aside. 5, 5. The continuation of the long band, from the section, in its course towards the posterior surface of the base of the ventricles. 6, 6. The right surface of the septum ventriculorum. 7, 7. The fibres of the right surface of the septum ventriculorum, seen to be continuous with the internal surface of the short band, while some of the fibres pierce the band to constitute the accessory fibres of the superficial layer.—See fig. 1, Nos. 4, 4. 8, 8. The fibres of the upper part of this surface of the septum are continuous with the internal surface of the long band. These fibres are derived from the right segment of the root of the aorta, 9. 10. The pulmonary artery. 11, 11. A layer of fibres derived from the margin of the root of the pulmonary artery, taking a spiral course around the internal surface of the right ventricle, and constituting its internal layer. This layer is augmented by fibres from the columnæ papillares of the right ventricle, and is continuous at the posterior ventricular groove with the long band directly that it has passed through the septum. 12. The left ventricle.

Plate 20.

Fig. 1.

Fig. 2

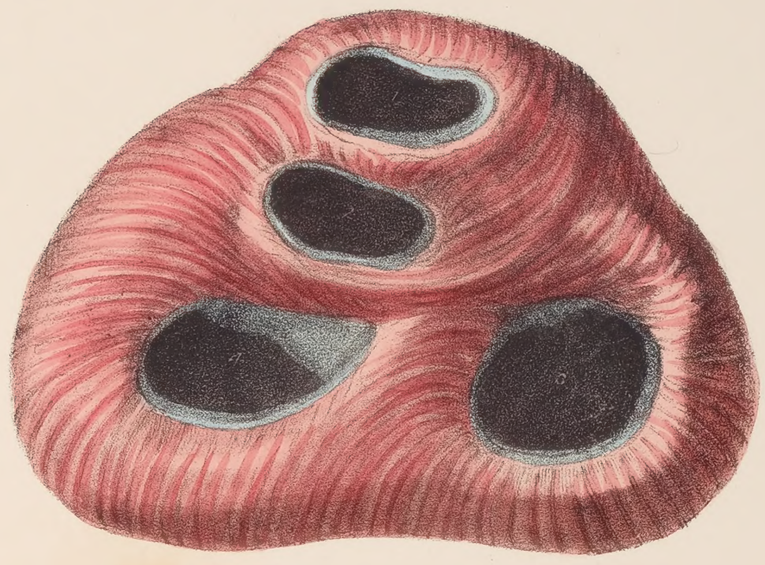
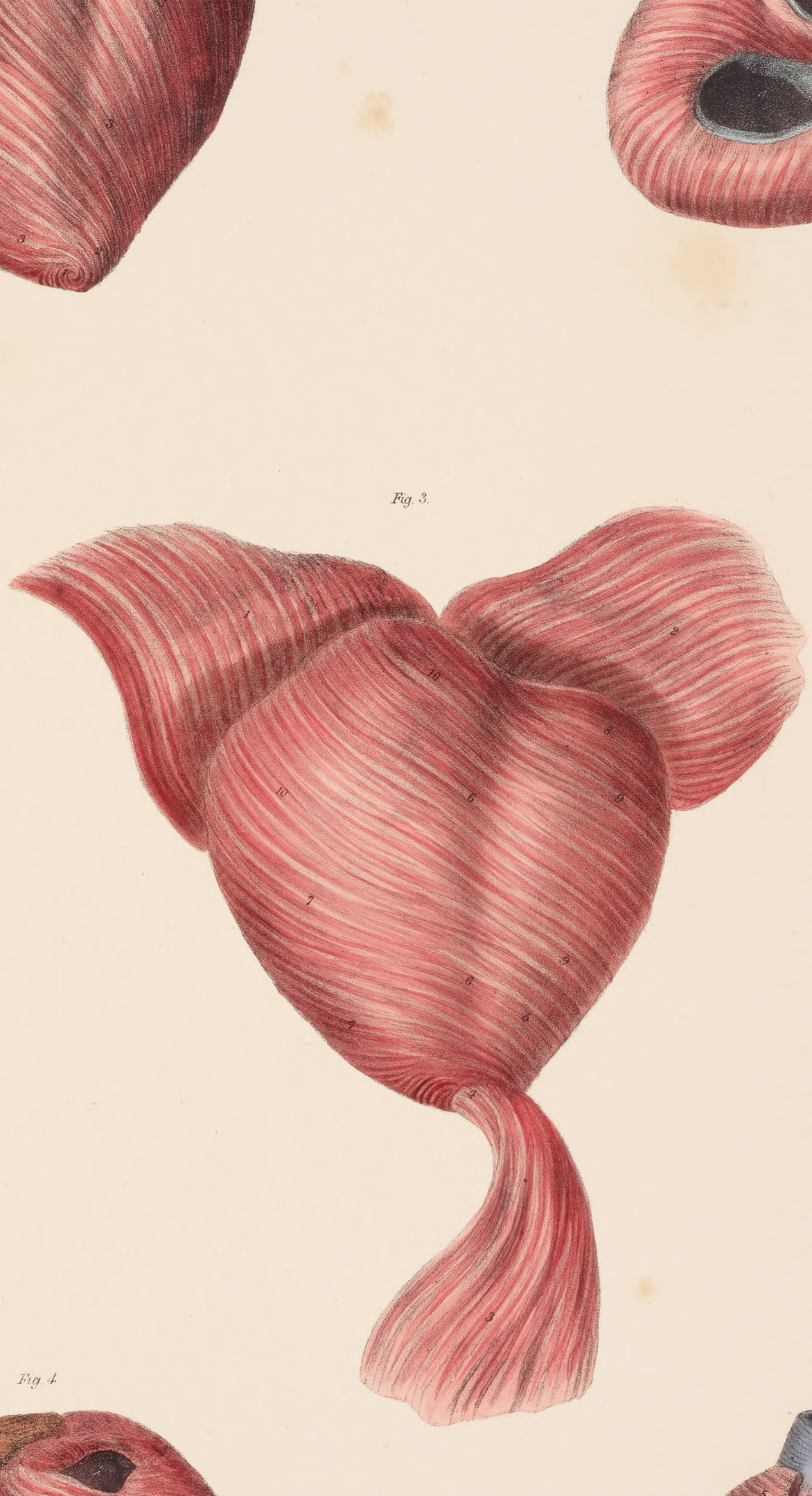


Fig. 3.



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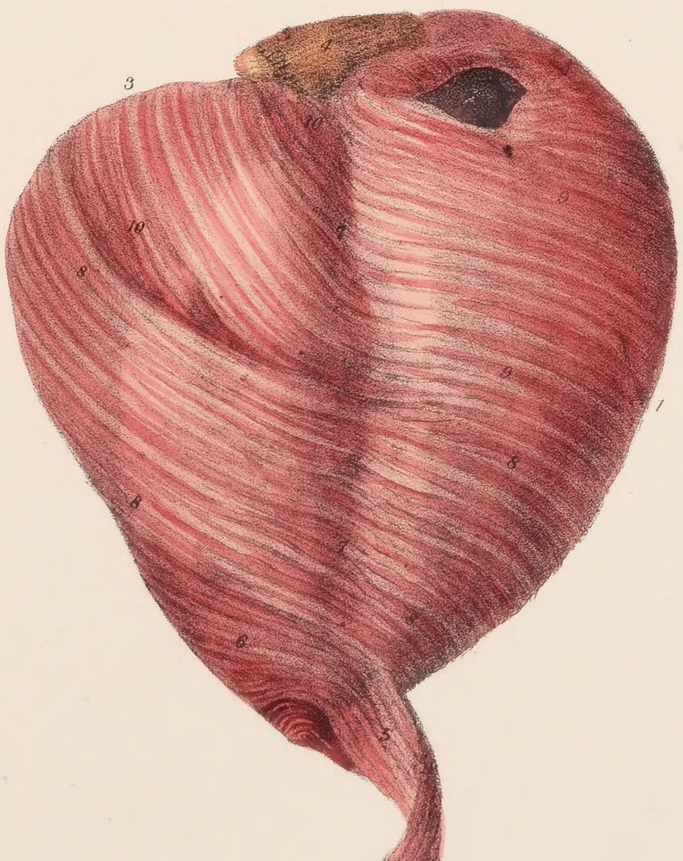

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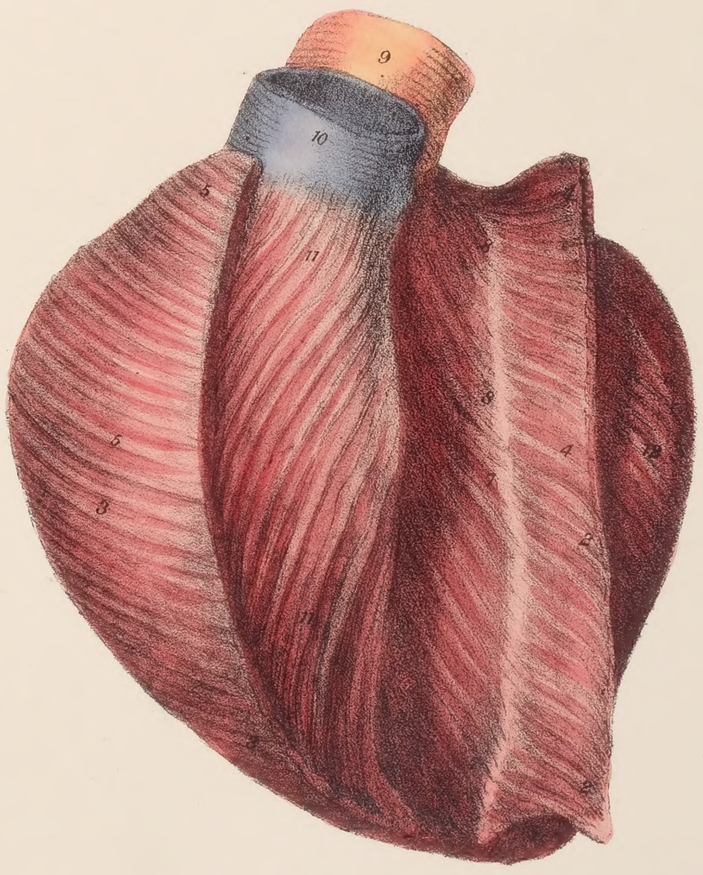

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Plate 21.

Fig: 1.

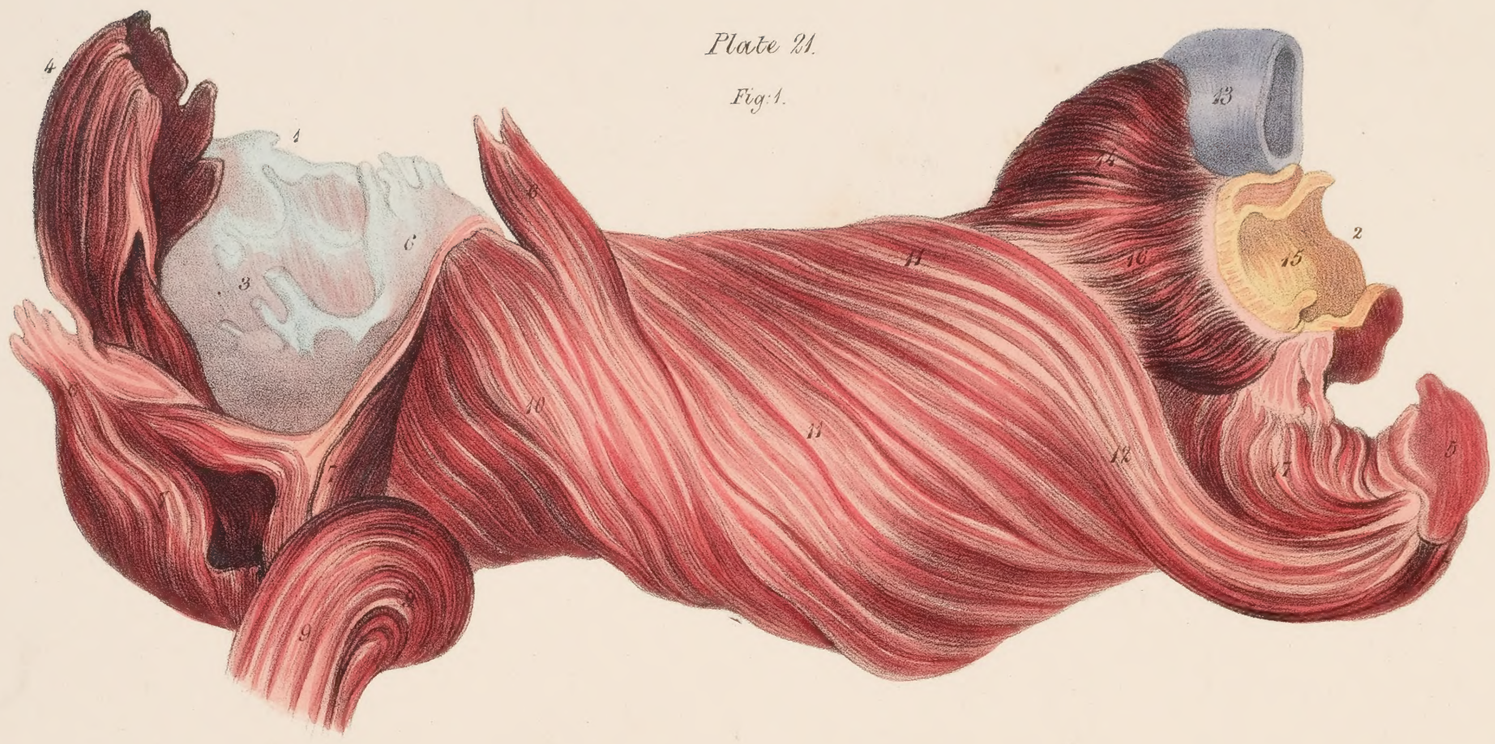


Fig: 2.

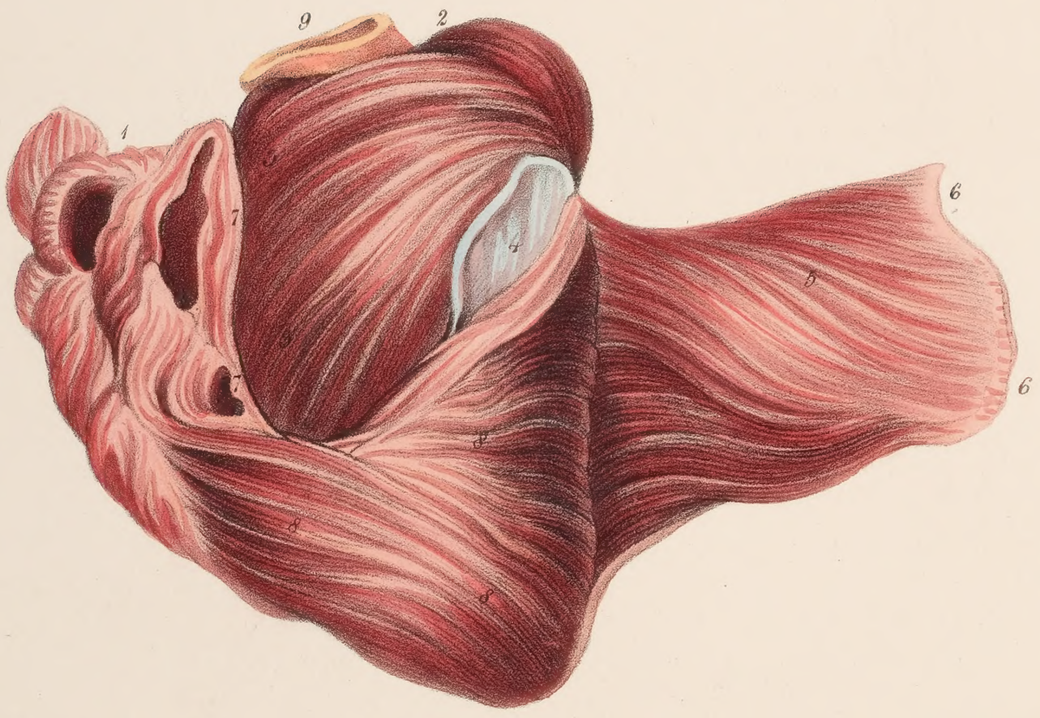
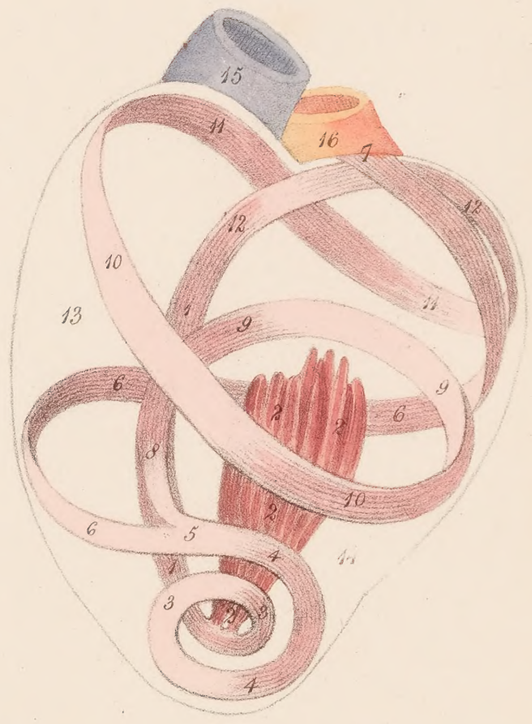


Fig: 3.



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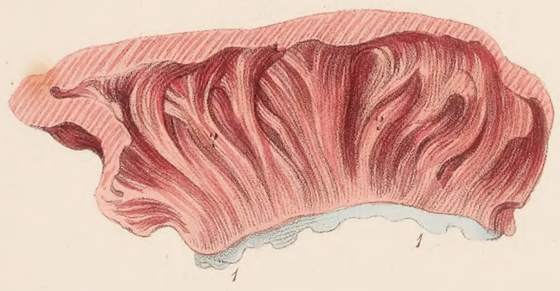


Fig: 5.

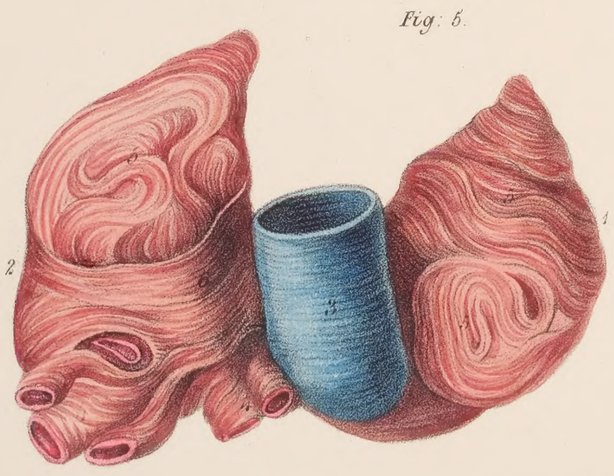
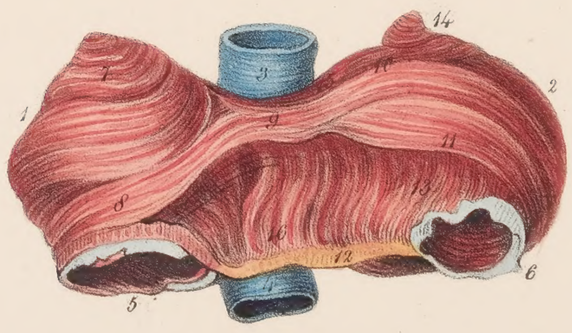


Fig: 6.



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substance of the gland is exposed, which is found to be of the conglomerate kind, being formed of numerous lobes, connected together by a second covering of reticular tissue, uniting the lobes to each

PLATE XXI.

The anatomy of the fibres of the heart, according to the researches of Searle. The figures (with the exception of fig. 3) are drawn from dissections made by Mr. Searle, and very liberally placed at the disposal of the editors of this work.

Fig. 1. The fibres of the heart unwound, so as to show the mode of connection of the fibres forming the two ventricles.

No. 1. The left ventricle. 2. The right ventricle. 3. The cavity of the left ventricle. 4. The rope divided just as it is about to spread out upon the internal surface of the septum ventriculorum. 5. The corresponding section of the rope, forming a part of the brim of the left auriculo-ventricular opening. 6, 6. The carneæ columnæ of the left ventricle. 7, 7. Radiated expansions of the fibres of the carneæ columnæ. 8. Some of the fibres of the rope (No. 1), proceeding from its radiated expansion. 9, 9. A band of fibres derived from the carneæ columnæ and rope, winding spirally around the apex of the heart, closing the left ventricle, and then forming the superficial layer of fibres of the heart. 10. Fibres derived from the carneæ columnæ and radiated expansion of the rope, forming in the natural state of the heart the thick band of the apex of the left ventricle, represented in plate XX. fig. 3, No. 5. 11, 11. The fibres derived from the carneæ columnæ and rope, which in the direction of a line drawn between these two figures, corresponding with the anterior coronary track, divides into the short and long bands. 12. Fibres passing onwards to assist in forming the rope, No. 5. 13. The pulmonary artery. 14. The fibres proceeding from the pulmonary artery to form the inner layer of the right ventricle. 15. The left section of the aorta. 16. Fibres proceeding from the margin of the aorta, and assisting to form the right layer of the septum ventriculorum. 17. Fibres proceeding from the aorta to assist in forming the rope.

Fig. 2. The heart, viewed upon its anterior surface, and showing the internal layer of fibres of the left ventricle.

No. 1. The right ventricle, in which the layers of fibres have been irregularly divided. 2. The rope, forming the brim of the left auriculo-ventricular opening, and showing the twisted disposition of its fibres. 3, 3. The fibres of the rope, expanding so as to form a radiated band, which constitutes the left surface of the septum ventriculorum. 4. The heads of the carneæ columnæ of the left ventricle. 5, 5. A band formed by fibres from the two preceding sources, after winding around the anterior surface of the left ventricle; the divided edge, 6, 6, becomes continuous with the middle layer of the septum, 7, 7. 8, 8. Another portion of this broad and thick band, which is wound around the apex of the left ventricle, and forms the short band of the heart. 9. The aorta.

Fig. 3. A diagram, showing the direction of the bands of fibres forming the layers of the ventricles of the heart.

Nos. 1, 1. The left layer of the septum ventriculorum, formed by fibres from the rope. 2, 2. Carneæ columnæ. 3, 3. A band formed conjointly by fibres from the two preceding sources. 4, 4. This band winding around the apex of the left ventricle to the septum, 5, where it divides into the short and the long band. 6, 6. The short band, receiving an accession of fibres at the septum, winds around the posterior part of the two ventricles, and terminates at 7, by being inserted into the anterior border of the auriculo-ventricular ring, and into the root of the aorta and pulmonary artery. 8. The long band, passing directly backwards through the septum, of which it forms the middle layer. 9, 9. The long band, after it has emerged from the septum, and is pursuing its course around the posterior part of the left ventricle, having received an accession of fibres from the internal layer of the right ventricle. 10, 10. The continuation of the long band across the anterior aspect of the two ventricles. 11, 11. The prolongation of the long band around the posterior part of the base of the heart. 12, 12. Its continuation, under the name of "the rope," to the point 1, where it becomes the left layer of the septum ventriculorum. 13. The right ventricle. 14. The left ventricle. 15. The pulmonary artery. 16. The aorta.

Fig. 4. An internal view of a section of the right auricle, showing the mode of distribution of its fibres. This preparation is made from the heart of a horse.

Nos. 1, 1. The fibrous margin of the right auriculo-ventricular ring. 2, 2. The fibres proceeding from this ring forming columns as they ascend, from which branches are given off, which sub-ramify.

Fig. 5. A posterior view of the auricles of the heart, with the mode of distribution of the muscular fibres upon their external surface.

No. 1. The right auricle. 2. The left auricle. 3. The superior vena cava. 4, 4. Openings of the pulmonary veins. 5, 5. The fibres of the two auricles disposed in a convoluted manner. 6. The posterior band of the fasciculus of fibres, fig. 6, No. 8, passing from the anterior aspect of the auricles, and encircling the openings of the pulmonary veins.

Fig. 6. An anterior view of the two auricles, showing the arrangement of their fibres.

No. 1. The right auricle. 2. The left auricle. 3. The superior vena cava. 4. The inferior vena cava. 5. The fibrous ring of the right auriculo-ventricular opening. 6. The fibrous ring of the left auriculo-ventricular opening. 7. The fibres winding in a spiral direction around the appendix of the right auricle. 8. A band formed by these fibres, continued across the septum, at 9, to the anterior surface of the left auricle. 10. The prolongation of these fibres, forming a superior band, which encircles the apex of the auricle. 11. An anterior band, which passes completely around the auricle, and, returning in its circle, is partly attached to the margin of the aorta, 12, and partly continued onwards, 13, to the appendix auriculæ, 14. 15. A posterior band of fibres, which is prolonged backwards to the posterior surface of the left auricle. 16. A band of fibres proceeding from the margin of the aorta to the superior vena cava, and entering into the formation of the septum auriculorum.

other."* Now, the size of the lobes varies considerably, some being as small as a pin's head, whilst others are as large as a pea. If a section of the gland be made, an elongated cavity will be found in its interior, containing an albuminous fluid, and round this the lobes are disposed in a peculiar way. In order to understand the relation which subsists between the cavity and the lobes, and the structure and mode of connection of the latter, it becomes necessary to unravel one of the lateral masses. In order to effect this, Sir Astley observes :† "to unravel it satisfactorily, it is necessary to dissect it, in part, in water, and then harden it in alcohol, when the dissection may be minutely pursued." After this is effected, it will be found that the lobes are connected by a strong fasciculus—a rope, in fact, round which they are attached like knots, and that "these ropes are disposed spirally around a central, or nearly central cavity." In this position they are retained by the cellular envelope externally, and the mucous lining of the cavity internally, as well as by the different vessels. Every lobe, or rather lobule, contains several small cavities, each of which resembles a small cul-de-sac, being "a secretory cell for producing the fluid" above alluded to. The cells of each lobule open into a small pouch at its base, and this, in turn, communicates with the large central cavity of the gland. "If a pipe be introduced into the gland, and alcohol be injected, and the organ then be immersed in strong spirit, or a solution of alum, a large cavity (that just referred to) will be filled, which I shall call the reservoir of the thymus."‡ The reservoir extends through the thoracic and cervical portions of the gland, being larger in the former. It is lined by a vascular mucous membrane, which is evidently prolonged through the pouches into the cells.

The reservoir, pouches, and cells contain a white fluid "like chyle," or "like cream, but with a small admixture of red globules." In the human fœtus this fluid has been found by Sir Astley in too small proportion to be submitted to chemical analysis. But the thymic fluid of the fœtal calf, which exists in great abundance, gave the following analytical§ results :— one hundred parts of the fluid contained sixteen parts of solid matter, which consisted of,

Incipient fibrine,	Muriate and phosphate of potash,
Albumen,	Phosphate of soda,
Mucus, and muco-extractive matter,	Phosphoric acid, a trace.

Sir Astley Cooper concludes his anatomical description of this gland with the following interesting physiological observation :—

"As the thymus secretes all the parts of the blood, viz. albumen, fibrine, and particles, is it not probable that the gland is designed to prepare a fluid well fitted for the fœtal growth and nourishment from the blood of the mother, before the birth of the fœtus, and consequently before chyle is formed for food?—and this process continues for a short time after birth, the quantity of fluid secreted from the thymus gradually declining as that of chylification becomes perfectly established."

Vessels and Nerves.—The thoracic part receives its arteries from the internal mammary artery; the cervical from the superior thyroid, and sometimes from the inferior thyroid. The veins run a different course from the arteries, and open, for the most part, into the vena innominata. The nerves are very minute; Haller thought they were derived from the phrenic; Sir A. Cooper says that he could not trace any branch from that nerve going to the gland; some evidently pass along it, and even through its cellular envelope, but they proceed on to the pericardium. He further observes, that a plexus is formed by branches from the sympathetic upon the internal mammary artery, and that filaments from this plexus pass along upon the thymic artery, which in a manner guides them to the gland. Besides this, "he has seen a filament from the junction of the par vagum and sympathetic pass on the side of the thyroid gland to the thymus." As to absorbents, Sir Astley has succeeded in injecting them only once in the human subject; but in the fœtal calf they pass nearly straight along the posterior surface of the gland, and terminate in the vena innominata. They are sufficiently large to admit an injecting pipe, and to receive ordinary coarse injection. The remarks upon them thus conclude: "These vessels, I consider, and shall name, the *absorbent ducts* of the gland; they are the carriers of the fluid from the thymus into the veins, at the lower part of the neck."

Not content with stating the result of his researches, the distinguished author details his methods of conducting them, obviously to abridge the labour of those who are not as well versed as himself (and few are) in anatomical pursuits.

* Op. cit. p. 27. † Op. cit. p. 28. ‡ Op. cit. p. 29.

§ This analysis was conducted by Dr. Dowler of Richmond.

THE URINARY ORGANS.

These consist of the organs by which the urine is secreted (kidneys), and those by which it is excreted, namely, the ureters, the bladder, and the urethra.

The Kidneys.—The kidneys (plate XXIV. *renes*, νεφροι) are two in number; but this is not invariable, as in some rare cases three have been found, while in others but one existed. They communicate each by a separate duct (ureter), with a reservoir (the bladder), which receives the secretion of both. They are placed deeply at the posterior part of the abdomen behind the peritonæum, lying one on each side of the vertebral column, on a level with the two last dorsal and two first lumbar vertebræ; the right is, however, a little lower down than the left. The kidneys are covered by a quantity of loose cellular tissue, which sometimes contains much dense fat. They are of a deep red colour. Each measures about four inches in length and two in breadth; the form is peculiar,—being compressed and ovoid, the kidney presents for examination two surfaces and two borders.

The anterior surface, convex, lies behind the peritonæum, which separates it on the right side from the duodenum and ascending colon, and on the left from the descending portion of the latter; the posterior is embedded in cellular tissue, and supported partly on the broad part of the diaphragm, partly on the quadratus lumborum, or rather on the anterior lamina of the fibrous membrane by which the transversalis abdominis muscle is connected to the spine; the external border is convex in its general outline, the internal concave, and excavated at the middle, where it presents a fissure for the transmission of the vessels. The superior extremity, which is thick, rounded, and inclined inwards, supports the supra-renal capsule: the inferior is smaller, somewhat flat, and diverges from the spine.

Structure.—The surface of the kidney is invested by a thin, yet firm membrane, which turns over the concave border, and comes into contact with its pelvis, on which it is reflected, gradually degenerating into cellular tissue. If a section be made of the organ from the convex to the concave border, it is seen to be formed of two substances, differing materially one from the other; these, from their relative position, are usually named cortical and medullary.

The *cortical substance* substantia corticalis), placed immediately under the investing membrane, occupies the entire circumference of the organ, being about two lines in thickness, and sends inwards prolongations, between which the medullary portion is placed. It is of a deep red colour, easily torn, and is formed almost entirely by the capillary terminations of blood-vessels. The *medullary part* consists of a series of pyramidal or conical masses, the bases of which are directed towards the surface of the kidney, and the small extremities towards its fissure; the cones are invested, except at their apices, by the cortical substance. The medullary substance is more dense than the preceding, and the colour is much less dark. From being made up of a series of minute tubes, it is also named *tubular substance;* a term preferable to medullary, which is altogether objectionable.

In the kidney we follow, as in the liver, its component parts into the interior, with a view to ascertain their mode of arrangement, as on this its structure depends. The fissure of the kidney lodges the renal artery and vein, the nerves and lymphatics, together with the commencement of the excretory duct. This last (the ureter) expands opposite the fissure of the kidney into an irregularly oval and compressed ampulla, called the *pelvis*, which is partly concealed by the vessels. If the ureter and pelvis be inflated, or, what is better, if they be distended with soft injection, it will be found, on dissecting off the anterior wall of the kidney, that on entering its substance the pelvis gives off three tubes, one corresponding with each extremity, and another with the middle of the organ; these again subdivide into from seven to thirteen smaller tubes (*infundibula*), and the infundibula terminate in cup-like cavities (*calices*), formed by their extremities being depressed, or, as it were, slightly inverted on themselves.

Each calyx embraces the extremity of one, sometimes of more rounded processes (*papillæ*, *mammillæ*), and each papilla is the summit of a conical mass, whose base looks towards the circumference of the kidney, and is, together with the sides, embedded, as it were, in the cortical part of the kidney. The conical masses are usually more numerous than the calices, in which they terminate: each is composed of minute tubes, (*tubuli uriniferi*,) of which one extremity opens on the surface of the papilla, and therefore pours its contents into the investing calyx; whilst the other, prolonged to the base of the cone, ramifies through the cortical substance of the kidney, forming an intricate plexus with neighbouring tubuli, and terminates by a cæcal extremity. These tubuli communicate frequently with each other, and are surrounded by a fine net-work of capillary vessels, by which the

urine is secreted. After its elaboration, it is received by the tubuli, and is thence passed on successively by the calices, infundibula, and pelvis, whose structure is similar to that of the ureter, being but so many prolongations of it. Though the mucous membrane of each calyx appears to cease where it is reflected over the surface of the papilla, yet we can scarcely avoid coming to the conclusion that it is prolonged into the tubuli uriniferi, as there is no part of the economy in which an excrementitious fluid is allowed to rest on the structure of an organ unprotected by a tegumentary membrane. Again, though the fibrous investment of each infundibulum and calyx seems also to cease at the margin of the papilla, it is more than probable that it also is prolonged, so as to become continuous with the fibres which constitute the tubuli.

Vessels and nerves of the Kidney.—The renal *artery* is derived from the aorta, and divides into five or six branches previously to entering the fissure of the kidney; its branches pass between the

PLATE XXII.

The anatomy of the thymus gland. The figures of this plate, and of the succeeding, have been copied, with the kind and liberal permission of Sir Astley Cooper, from that distinguished author's beautiful monograph, "The Anatomy of the Thymus Gland."

Fig. 1. The thymus gland of the human embryo at rather more than two months.

No. 1. The larynx and trachea. 2. The gland, presenting a bilobate form. 3. The heart.

Fig. 2. The thymus gland in an embryo at the third month.

No. 1. The thyroid gland, resting upon the upper part of the trachea, and concealing the larynx. 2. The trachea, bounded on each side by the common carotid artery. 3. The thymus gland. 4. The heart.

Fig. 3. The thymus gland in a fœtus at the fourth month.

No. 1. The larynx, partly concealed by the thyroid gland. 2. The trachea, bounded laterally by the common carotid arteries. 3. The thymus gland; the median division into two lateral portions is distinctly perceived. 4. The heart.

Fig. 4. The thymus gland in the fœtus at the fifth month.

No. 1. The larynx and trachea, partly concealed by the thyroid gland. 2. The right lateral portion of the gland, extending upwards by the side of the trachea and larynx to the ala of the thyroid cartilage. 3. The left lateral portion. 4. The heart.

Fig. 5. The thymus gland in a fœtus at the sixth month.

No. 1. The larynx and trachea. 2. The thymus gland; its lateral portions extending upwards on either side of the trachea, and resting inferiorly on the heart. 3. The heart.

Fig. 6. The thymus gland of a fœtus at the seventh month. The position and extent of the gland are well exhibited in this figure.

No. 1. The larynx. 2. The right lateral portion of the gland. 3. Its left lateral portion. 4. The heart.

Fig. 7. The thymus gland from an anencephalous fœtus at the eighth month; "the organ is broader than usual," and the cervical portions appear deficient.

No. 1. The thyroid cartilage. 2. The thyroid gland. 3. The trachea. 4. The right lateral portion of the thymus gland. 5. Its left lateral portion. 6. The heart.

Fig. 8. The thymus gland at the ninth month.

No. 1. The thyroid gland, lying upon the upper part of the trachea; the ramified vessels upon this gland are chiefly thyroid veins. 2. The right lateral portion of the thymus gland. 3. Its left lateral portion. 4. The right auricle of the heart. 5. The right ventricle. 6. The appendix of the left auricle. 7. The left ventricle.

Fig. 9. One of the lateral portions of the thymus gland, hardened in alcohol, and freed from surrounding cellular tissue. It "shows the serpentine course of the lobes of which the gland is composed."

Fig. 10. "The glands injected with wax, and partially unravelled." This figure, adds Sir Astley Cooper, in a note, "is drawn from one of my best preparations."

No. 1. The cervical portion of the left gland. 2. The thoracic portion. 3. The isthmus of communication between these two portions. 4. The cervical portion of the right gland. 5. Its thoracic portion. 6. The isthmus of communication between the two. The lobes,—with their smaller component structures, the cells,—are beautifully seen in this preparation; and, in consequence of the unravelling, the rope is also well exhibited in the right gland.

Fig. 11. "The spiral course of the lobes, shown by unravelling the rope of which each gland is composed."

Fig. 12. "The rope still farther unravelled, and portions of the reservoir opened where the lobes coalesce."

Nos. 1, 1. Portions of the reservoir laid open.

Fig. 13. "The thymus gland of a full-grown fœtus, filled with alcohol, and hardened in it; shows the form, course, and size of the reservoirs, the mouths of the pouches proceeding from them, and the secretory cells in the walls of the gland."

No. 1. The cervical portion of the gland. 2, 2. Its thoracic portion. 3, 3. The reservoir of the cervical portion. 4, 4. The reservoir of the thoracic portion. 5, 5. Secretory cells and pouches seen in the walls of the gland. 6, 6. The pores, or openings of the secretory cells and pouches, upon the internal surface of the reservoir.

Fig. 14. "Portions of the lobes sliced off after they have been distended with alcohol, to show the secretory cells and pouches."

Plate 22.

Fig 1.

Fig 2.

Fig. 3.

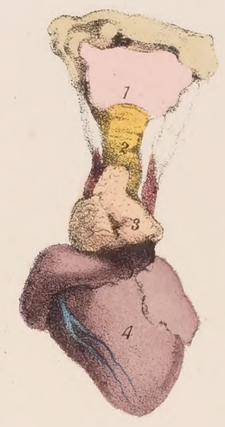

Fig. 4.

Fig. 8.

Fig 7

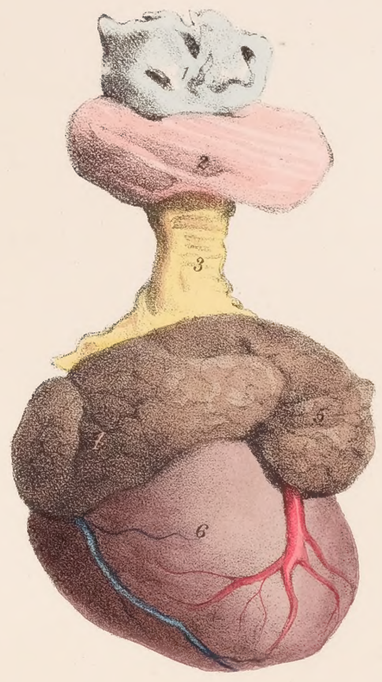

Fig. 6.

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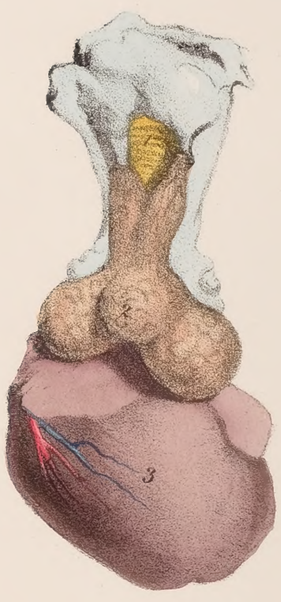

Fig. 9

Fig 10.

Fig. 11.

Fig. 12.

Fig. 13.

Fig. 14.

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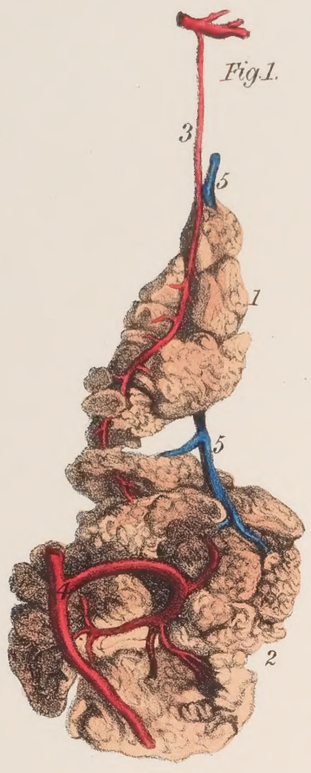
Plate 23.

Fig 1.



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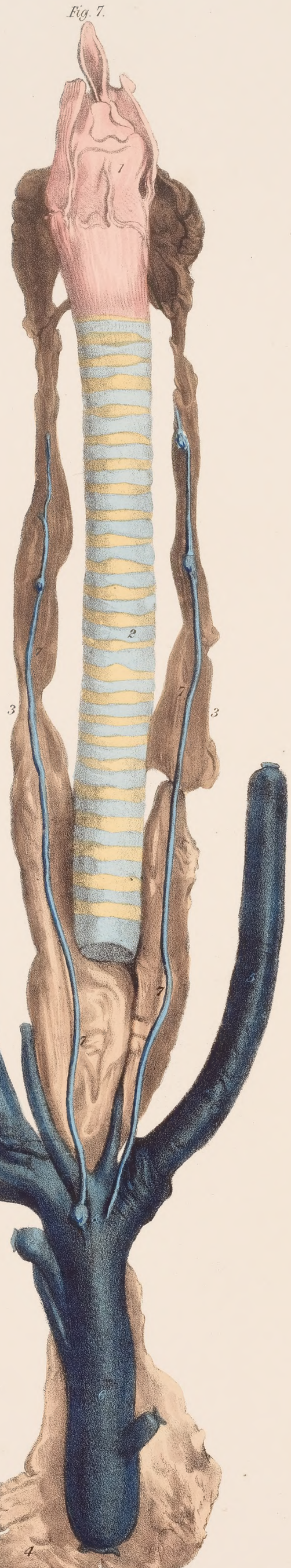

Fig 2.

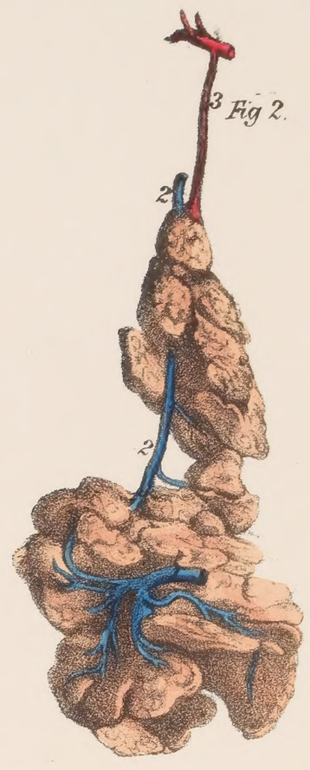

Fig 3.

Fig 4.

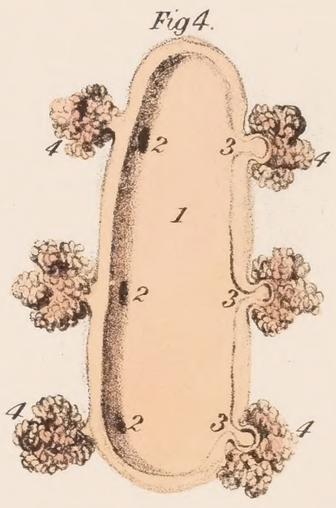

Fig 5.

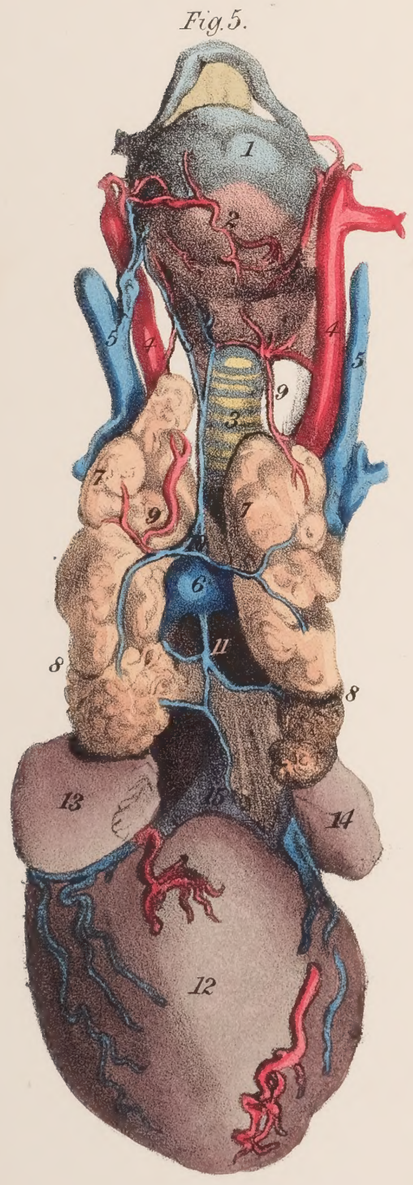

Fig 6.

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papillæ, and so continue until they reach the bases of the conical masses, where they divide and ramify, so as to form a complete vascular net-work, encasing the inner or tubular structure, and so forming a cortex, or exterior investment for it. The minute ramifications of the artery form in the cortical structure of the organ a multitude of extremely small bodies, called glomeruli (*corpora Malpighiana*). These glomeruli are about $\frac{1}{130}$ of an inch in diameter, and are composed of an aggregated plexus of capillary vessels, enclosing a small central cavity, the use of which is unknown. The radicles of the renal vein, commencing from the capillary vessels, convey the effete blood into the course of the circulation, and open into the inferior vena cava. The lymphatics of the kidney are very numerous. The *nerves* (which are derived from the renal plexus of the sympathetic system) are, on the contrary, comparatively few; their distribution has not been followed to any considerable depth in the substance of the organ.

During fœtal life, the surface of the kidney is marked by deep fissures, which indicate its division at that period into several lobules. These contain each the elements of a distinct organ; they gradually become united, and at length the kidney assumes the uniform appearance seen in the adult. The lobulated condition of the kidney is permanent in many of the lower animals.

Supra-renal capsules.—The *supra-renal capsules* are so named from surmounting the kidneys; other names have been given them from hypotheses concerning their use (atrabiliary capsules, renes succenturiati). Each of these bodies is compressed, and rather flat; the upper border is convex, the lower is excavated, and rests on the superior extremity and partly on the inner border of the kidney, to which it is united by cellular tissue. They are formed of two substances: an external, which is dark yellow in colour, somewhat dense and striated; and an internal, which is deep brown, soft, and pulpy. The interior is hollowed into a small triangular cavity, containing a viscid fluid. Some anatomists, however, believe that this cavity is produced by the decomposition of the pulpy substance in which it is found.

In early fœtal life the supra-renal capsules are granular in structure, and exceed the kidneys in

PLATE XXIII.

The anatomy of the thymus gland. The figures in this plate, with those in the preceding, have been copied, with the kind and liberal permission of Sir Astley Cooper, from that distinguished author's beautiful monograph, "The Anatomy of the Thymus Gland."

Fig. 1. The arteries of the thymus gland.

No. 1. The cervical portion of the gland. 2. Its thoracic portion. 3. A branch of the internal mammary artery. 4. A branch of the inferior thyroid artery. 5, 5. A venous branch.

Fig. 2. The veins of the thymus gland.

No. 1. A venous trunk collecting the returning blood from the thoracic portion of the gland, and terminating in the vena innominata. 2, 2. A vein proceeding along the cervical portion of the gland to open into the inferior thyroid veins. 3. The branch from the inferior thyroid artery.

Fig. 3. Two sections of the thymus gland, its cavities having been distended with alcohol.

No. 1. Shows a part of the reservoir, with the pores upon its internal surface; and the pouches and secretory cells in the parietes of the gland. 2. Shows the cavities of the pouches and the secretory cells in a section made near the surface of the gland.

Fig. 4. A diagram, which is intended to convey a general idea of the structure of the thymus gland.

No. 1. The reservoir. 2, 2. The openings of pouches upon the internal surface of the reservoir. 3, 3. Pouches laid open by a section. 4, 4. Lobes; the lobes being made up of small granular lobules, which are the secretory cavities or cells.

Fig. 5. The arteries and veins of the thymus gland: the gland itself is injected with wax.

No. 1. The larynx. 2. The thyroid gland. 3. The trachea. 4, 4. The common carotid arteries. 5, 5. The internal jugular veins. 6. The left vena innominata. 7, 7. The cervical portion of the gland. 8, 8. Its thoracic portion. 9, 9. Arteries supplying the gland, proceeding from the inferior thyroid arteries. 10. A vein which opens into the upper part of the left vena innominata. 11. Another thymic vein opening into the lower part of the left vena innominata. 12. The heart, upon which the coronary vessels are seen to be distributed. 13. The right auricle. 14. The left auricle. 15. The root of the pulmonary artery.

Fig. 6. The thymus gland at the ninth month, injected with wax to show its lobes and cells.

No. 1. The larynx. 2. The trachea. 3, 3. The common carotid arteries. 4, 4. The cervical portion of the gland. 5, 5. Its thoracic portion. 6. The heart. 7. The root of the pulmonary artery. 8. The right auricle. 9. The left auricle.

Fig. 7. A posterior view of the thymus gland in the fœtal calf, intended to show the large lymphatic vessels (thymic ducts), which proceed from the upper extremity of the cervical portion of the gland, and terminate in the large vessels at the root of the neck.

No. 1. The larynx. 2. The trachea. 3, 3. The cervical portion of the gland. 4. Its thoracic portion. 5, 5. The internal jugular veins. 6. The superior vena cava. 7, 7. The thymic ducts. 8. The point of termination of these ducts in the superior part of the superior vena cava.

size; the latter, however, rapidly increasing, become much the larger towards the end of that period. After birth, the supra-renal capsules even become diminished, and apparently shrivelled.

In structure it is composed of two substances, cortical and medullary. The cortical substance is of a yellowish colour, and consists of straight parallel fibres placed perpendicularly side by side. The medullary substance is generally of a dark brown colour, double the quantity of the yellow substance, soft in texture, and contains within its centre the trunk of a large vein—the vena supra-renalis. It is the large size of this vein that gives to the fresh supra-renal capsule the appearance of a central cavity; the dark-coloured pulpy or fluid contents of the capsule, at a certain period after death, are produced by softening of the medullary substance. Dr. Nagel* has shown, by his injections and microscopic examinations, that the appearance of straight fibres in the cortical substance is caused by the direction of a plexus of capillary vessels. Of the numerous minute arteries supplying the supra-renal capsule, he says, the greater number enter the cortical substance at every point of its surface, and, after proceeding for scarcely half a line in its substance, divide into a plexus of straight capillary vessels. Some few of the small arteries pierce the cortical layer and give off several branches in the medullary substance, which proceed in different directions, and re-enter the cortical layer to divide into a capillary plexus in a similar manner with the preceding. From the capillary plexus composing the cortical layer the blood is received by numerous small veins, which form a venous plexus in the medullary substance and terminate at acute angles in the large central vein.

Vessels and Nerves.—The supra-renal arteries are derived from the aorta, from the renal, and from the phrenic arteries; they are remarkable for the innumerable minute arteries into which they divide previously to entering the capsule. The *supra-renal vein*, collecting the blood from the medullary venous plexus, and receiving several branches which pierce the cortical layer, opens directly into the vena cava on the right side, and into the renal vein on the left.

The *lymphatics* are large and very numerous; they terminate in the lumbar glands. The *nerves* are derived from the renal and from the phrenic plexus.

The description of these bodies is placed in the present section in consequence of their connection with the kidneys, and not from any consideration of their function, about which there has hitherto been nothing more than conjecture.

Ureters.—The pelvis (renalis), which has been previously described, as receiving all the urine from the calices, gradually becomes narrowed, and, opposite the lower border of the kidney, assumes the name of ureter. This duct extends from the point here indicated to the posterior and inferior part of the bladder, into which the canals from both kidneys open. Each thus averages about eighteen inches in length; its calibre is usually compared to that of a quill.

The ureter, in its whole course, lies behind the peritonæum; superiorly, it rests against the psoas muscle, and is crossed by the spermatic blood-vessels (these being in front); lower down it passes over the common iliac vessels; lastly, in the male, the vas deferens crosses to its inner side immediately before it terminates.

In opening into the bladder, the ureters pass obliquely between its muscular and mucous coats, before they end on its inner surface; this arrangement has a valvular effect, preventing the fluid from passing back towards the kidney. The structure is the same as that of the pelvis, and consists of an external fibrous tunic, lined by a thin mucous membrane.

Urinary bladder.—The bladder (vesica urinaria) is a musculo-membranous reservoir, placed deeply in the pelvis, behind the pubic symphysis, and before the rectum in the male, but separated from it by the uterus and vagina in the female. It receives the secretion of the kidneys by the ureters, and discharges it by the urethra.

In infancy, the bladder is elongated and pyriform in its shape, and contained altogether in the abdomen. At this period it may be considered as divisible into three portions; the rounded or upper extremity being with propriety called its *fundus*, the narrow tapering part the *neck*, the intermediate portion being the *body*. As the pelvis expands, the bladder gradually subsides into it, so as not to rise above its margin (at least in the adult) unless when distended, and at the same time assumes a remarkable change of form. It becomes a compressed oval, for the lower part of its body expands and subsides on the rectum, probably by the weight of the fluid it habitually sustains, and to this part is applied the term *base*, or "*bas-fond.*" Thus we are obliged to recur to the original application of the terms, in order to explain an apparent inconsistency in those employed; and the inconsistency is heightened by making the term "fundus" and "summit" synonymous, at the same time that "fundus" and "base" are applied to different parts of the same viscus. Yet, so the nomenclature runs: that

* Müller's Archiv. 1836.

which was the fundus in the fœtal bladder is not unfrequently called "summit," because it is the highest part.

The direction of the bladder is oblique, being inclined somewhat forwards and upwards, from base to summit; and, as it is being gradually distended, it comes forward more and more, the neck being fixed, whilst the fundus and body curve forwards and upwards with the distension. If examined in this condition, three ligamentous cords (viz. the urachus, and the remains of the umbilical arteries) will be observed to pass from its summit obliquely upwards behind the recti muscles to the umbilicus. Into its base two tubes are inserted, viz. the ureters; and at the sides the vasa deferentia pass obliquely backwards. Now all that part of the posterior surface and sides of the bladder included between these lines is covered by peritonæum, the remainder being uncovered. Thus, at the fore part, from the point of attachment of the urachus down to the neck of the bladder, no serous covering exists. In the collapsed condition all this lies behind the pubes; but, when distended, part of it rises above its margin, and is in contact with the recti muscles; inferiorly, from the entrance of the ureters to the urethra it is also uncovered, and on the sides from the vasa deferentia forwards to the surface of the pelvis.

The base and neck are the parts which deserve the greater share of attention. The *base* is that depending part of the viscus which rests on the rectum. Attached to it we find the vesiculæ seminales and vasa deferentia, so disposed as to leave between them an interval, in which the bladder is separated from the rectum only by some cellular tissue. This space is triangular in its form, the sides being formed by the vesiculæ converging to the prostate, whilst the base corresponds with the interval between the ureters It is by no means so extensive when the parts are *in situ*, as may be inferred from viewing them after they are disturbed. The vesiculæ are in close contact for some lines before they reach the base of the prostate; and as the peritonæum is being reflected off the bladder at the entrance of the ureters, it forms a curved fold, whose convexity inclines forwards in the interval between them. The *neck*, or constricted part at which the bladder is continuous with the urethra, is usually compared to a truncated cone, longer below and at the sides than above. In infancy it is oblique, its direction being downwards and forwards, but in the adult it becomes almost horizontal. The posterior part of it rests on the rectum, the rest being encircled by the prostate gland. In the female, the parts of the bladder last described are in close relation with the vagina, which is interposed between them and the rectum. Moreover, there are no organs appended to them, the vesiculæ and prostate being peculiar to the male.

The *inner surface* of the bladder is lined by mucous membrane, continuous with that which is prolonged upwards along the ureters, and downwards through the urethra. When collapsed, it presents throughout the body and fundus slight rugæ, or waving lines, which exist no longer in the distended condition. But towards the lower part, and corresponding with what we described, externally, as the base, a smooth and slightly raised surface appears, in which no rugæ occur under any circumstances. The shape of this part is that of a triangle, its two posterior angles being indicated by the openings of the ureters, and the anterior or apex by the commencement of the urethra: this part of the bladder is endowed with peculiar sensibility. It is the "*trigone vesical*" of Lieutaud and Camper;* its apex or anterior angle, from being slightly elevated, has also been named "*luette vesicale*" (*uvula vesicæ*). This corresponds to the third or transverse lobe of the prostate, which is placed beneath. Along the sides of the trigone, and under cover of the mucous membrane, muscular fibres extend from the prostate, diverging to the internal orifice of the ureters, and are fixed to both these points. The orifice of the ureters is not protected from the reflux of the urine by any valve; but the obliquity of their course through the substance of the bladder serves the purpose. Sir C. Bell supposes, that, as in contraction of the bladder, the point at which its outer coat is penetrated by the ureter is drawn towards the neck of the organ (its fixed point), and therefore opposite the internal orifice, the longitudinal fibres are intended to act on the latter at the same time; so that, drawing it proportionally forward towards the prostate, they may thus maintain the required obliquity.

Structure.—The bladder, like the other hollow viscera, is composed of three coats, or layers, united by cellular tissue. The peritonæal, or exterior coat, we have already noticed as forming a partial investment.

The *muscular* layer consists of pale fibres disposed in different directions, all of which are sometimes mentioned under the general name *detrusor urinæ*. The external fibres on the fore part may be seen to pass upwards from the neck to the summit, and thence downwards and backwards to the base of the prostate gland. On the sides they follow an oblique course. The internal set are for

* Camper, Fascic. Anat. Pathol.

the most part transverse, and towards the neck so nearly assume a circular direction, that some anatomists have considered them as a sphincter muscle (*sphincter vesicæ*). These are disposed immediately behind the prostate, and therefore behind the opening of the seminal vessels: they are most apparent inferiorly. When the bladder is distended, intervals occur between the bundles of muscular fibres in which the inner tunic is seen. The protrusion of the latter in these inter-spaces forming a species of hernia of the mucous membrane, will constitute what is called the sacculated bladder. The muscular fibres sometimes become much thickened (hypertrophied) by over-action, or in consequence of inflammation, and form considerable projections on the internal surface of the bladder, giving to it the peculiar appearance expressed among the French by the term "vessie à colonnes."

The *mucous* coat is smooth when distended, but corrugated when the bladder is contracted; its colour is pale, with a slight rose tint. The portion covering the "trigone" is smooth in all conditions of the organ, and paler than in any other part. The muscular and mucous membranes are united by a well-marked layer of cellular tissue, frequently mentioned as a separate coat, under the name vascular or nervous tunic.

Vessels and nerves of the Bladder.—In early life the bladder receives its arteries from the hypogastric; in the adult it is supplied by the proper vesical arteries, and by twigs derived from the hæmorrhoidal and internal pudic vessels, the greater number being towards the neck and base. Its veins form a plexus at the same situation, and open into those of the internal iliac. The lymphatics follow a similar course. The nerves come from the sacral plexus of the cerebro-spinal system and the hypogastric plexus of the sympathetic.

Ligaments of the Bladder.—The bladder is retained *in situ* by certain membranous reflections called ligaments. The fascia iliaca, it will be recollected, descends into the pelvis, becoming adherent to its margin; thence it is prolonged downwards, under the name fascia pelvica, to a level with an oblique line extended from the pubic symphysis to the spine of the ischium. At that point it contracts a close connection with the obturator fascia, after which it is continued on the inner surface of the levator ani, to the side of the bladder and prostate gland, with whose structure it becomes in a manner identified; from its destination, this last portion is sometimes called vesical fascia. A similar arrangement of the membrane takes place at the opposite side, and both are termed the *lateral ligaments* of the bladder. The fascia transversalis, it will be also recollected, is continued down behind the pubic symphysis, and on reaching the fore part of the neck of the bladder is reflected over the prostate on its upper surface. From the point of reflection two dense fasciculi of fibres (one at each side of the median line, with a slight cellular interval between them) pass also upon the upper surface of the bladder; these are the *anterior ligaments*. They are considered by some anatomists as tendons of attachment for the muscular fibres of the bladder to the symphysis pubis.

PLATE XXIV.

The anatomy of the kidney and supra-renal capsule.

Fig. 1. The left kidney, surmounted by the supra-renal capsule, and showing the relative position of its vessels.

Nos. 1, 1. Swellings upon the surface of the kidney, marking its original composition of distinct lobes. 2. The supra-renal capsule. 3, 3. Two branches of the renal artery. 4. The renal vein. 5. The supra-renal vein. 6. The pelvis of the kidney. 7. The ureter.

Fig. 2. A section of the kidney.

Nos. 1, 1. The cortical or vascular structure. 2, 2. The medullary or tubular structure, disposed in cones. 3, 3. The papillæ, or apices of the cones. 4, 4. Other papillæ, seen terminating by their apices in the infundibula of the organ. 5, 5. The calices. 6, 6, 6. The three infundibula. 7, 7. The pelvis of the kidney. 8. Its ureter.

Fig. 3. The microscopic structure of the kidney, according to Krause of Hanover.—From Müller's Archiv. for 1837.

Nos. 1, 1. Conical lobules, composed of the convolutions of the terminal uriniferous tubuli; tubuli uriniferi corticales. The tubuli, 2, 2, from these conical lobules, terminate in the bases of the cones of the tubular structure of the kidney, fig. 2, Nos. 2, 2. 3. A small artery, giving off branches to the glomeruli (4, 4), or Malpighian bodies. These are the globular bodies seen amongst the tubuli.

Fig. 4. The arrangement and dichotomous mode of division of the tubuli uriniferi in the tubular portion of the kidney.—After Schumlansky.

No. 1. The papilla of the cone.

Fig. 5. A supra-renal capsule, seen upon its posterior surface.

Nos. 1, 1. Cellular tissue, in which are seen a multitude of small thread-like vessels, principally arteries, converging to the surface of the organ.

Fig. 6. A section of the supra-renal capsule.

Nos. 1, 1. The light-coloured cortical portion of the organ. 2, 2. Its medullary portion, which is dark-coloured, and soft in texture. 3. The trunk of a large vein, found in the centre of the capsule,—vena suprarenalis.

Plate 24.

Fig. 1.

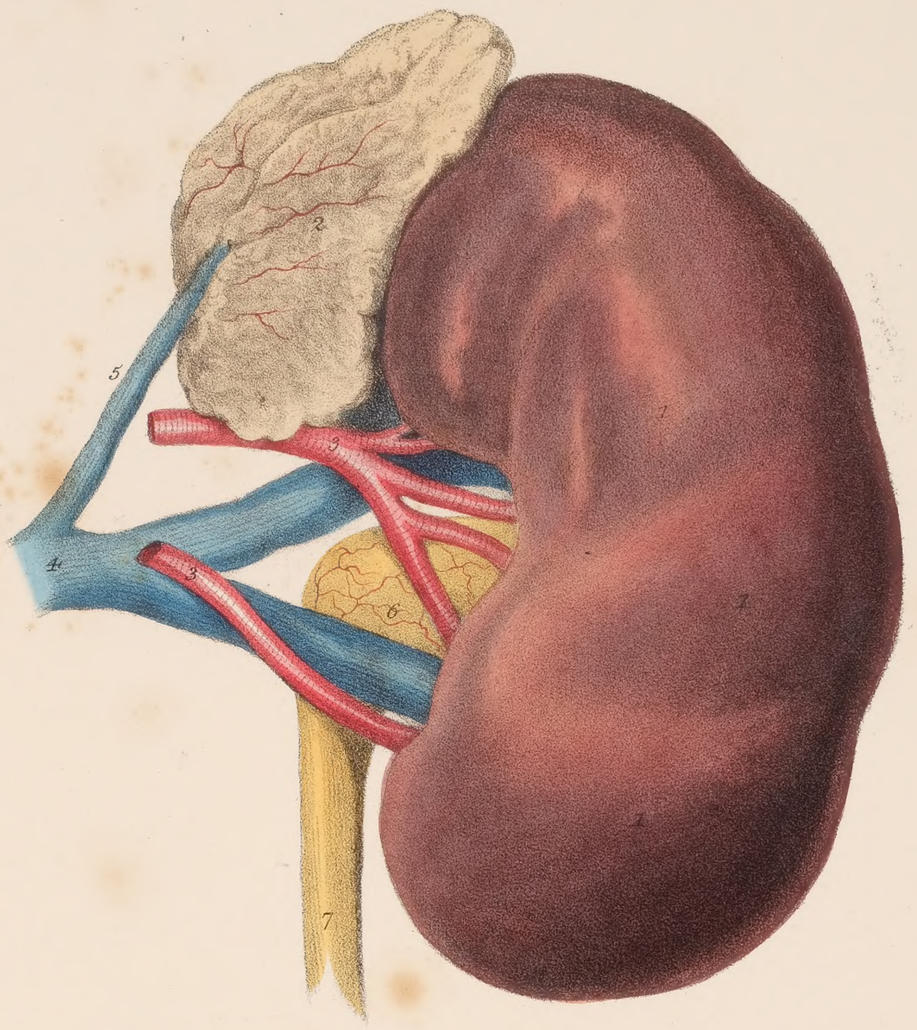


Fig. 6.

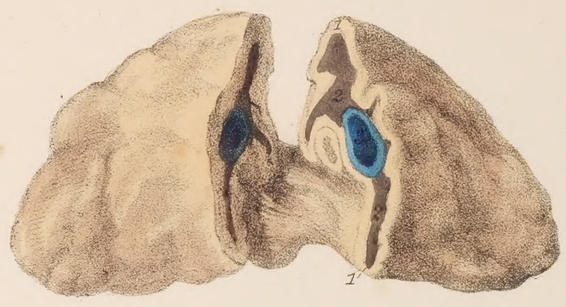


Fig. 4.

Fig. 5.

Fig. 3.

Fig. 2.

Drawn from Nature by W. Bagg.

London Taylor & Walton Upper Gower St.

W.J.E Wilson direxit

Wm Fairland lithog.

Plate 25.

Fig. 1.

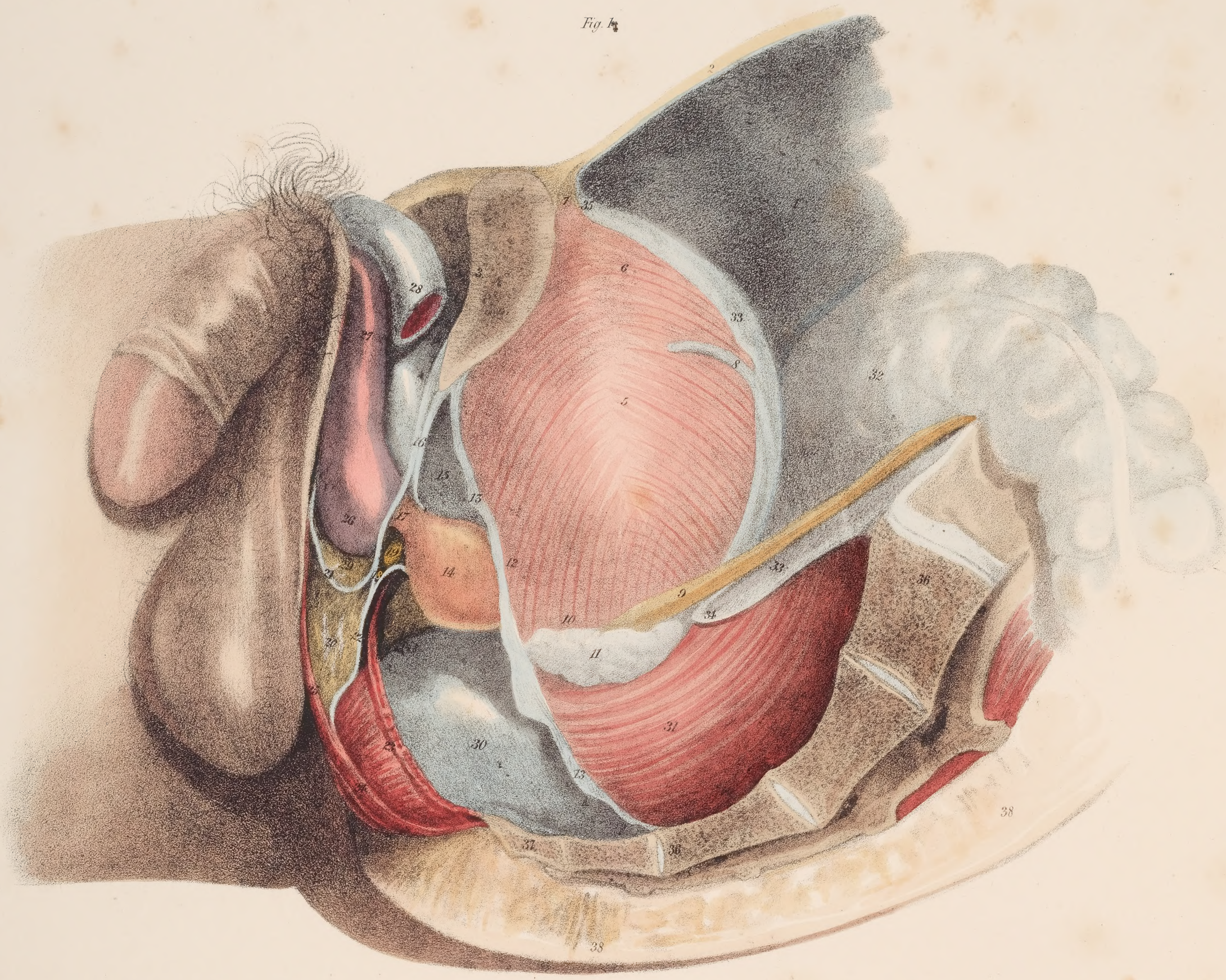


Fig. 2.

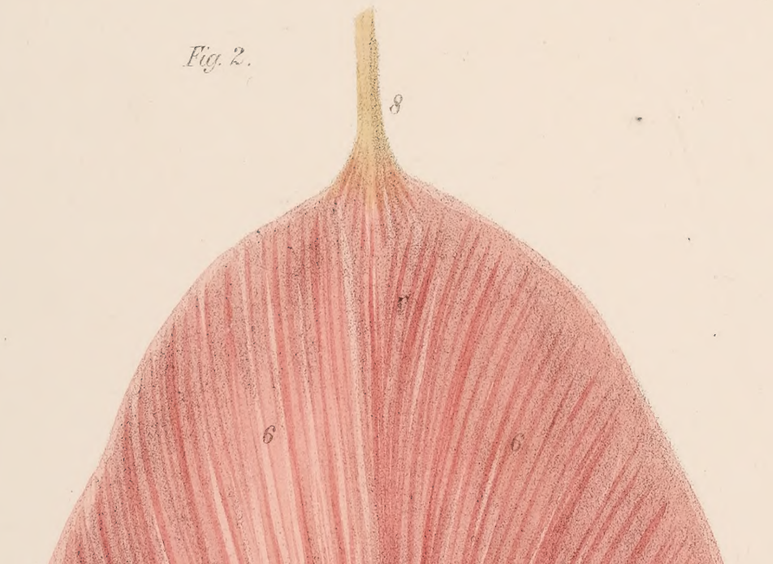
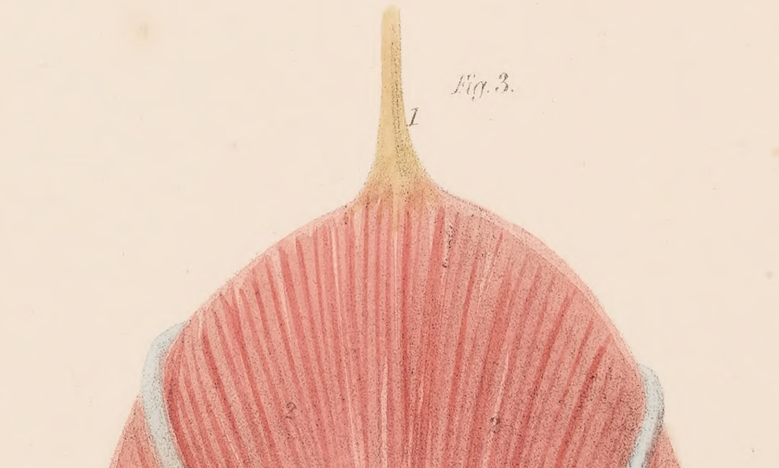


Fig. 3.



W.J. Erasmus Wilson direxit.

Drawn from Nature by W. Bagg.

London, Taylor & Walton, Upper Gower St.

Wm. Fairland lithe.

As the peritonæum is being reflected to and from the bladder, it necessarily forms certain folds or duplicatures, which have been termed ligaments. Two of these will be observed extending from its sides to the iliac fossæ, and two posteriorly, corresponding with the course of the umbilical arteries; but, instead of checking its motions, they serve rather as provisions to admit of the changes consequent on distension, and therefore should not be called ligaments.

Urachus.—The urachus is a fibro-cellular cord, extending from the apex of the bladder upwards towards the umbilicus, lying behind the linea alba, and in front of the peritonæum. Inferiorly, it is connected with the muscular fibres of the bladder; the superior extremity, prolonged upwards to the umbilicus, becomes united with the fibrous tissue of the linea alba. In man, the urachus appears to be merely the rudiment of a tube which, in his embryonic condition, as in inferior animals, communicates with the allantois. It perhaps serves to maintain the proper position of the upper part of the bladder, and, during its distension, prevents the peritonæum from being insinuated between it and the abdominal parietes.

Urethra.—The urethra is a membranous tube directed in the median line from behind forwards, beneath the arch of the pubes; by one extremity it is continuous with the neck of the bladder, by the other it opens externally. In the female, it serves simply for the excretion of urine; in the male, it is the outlet also for the seminal fluid.

The *female urethra* is about an inch and a half in length, and is slightly curved, the concavity looking forward. It lies embedded in the upper wall of the vagina, under cover of the anterior ligaments of the bladder. The external orifice (meatus urinarius) opens beneath the symphysis pubis, about

PLATE XXV.

The viscera of the pelvis.

Fig. 1. A side view of the viscera of the pelvis in their relative position.

No. 1. Part of the cavity of the abdomen. 2. The abdominal parietes. 3. The body of the os pubis sawn through somewhat to the left of the symphysis. 4. A fold of integument turned back from over the pubic region. 5. The body of the urinary bladder. 6. Its fundus. 7. The point of connection of the urachus. 8. The vas deferens, passing downwards to the vesicula seminalis. 9. The ureter of the left side, entering between the coats of the bladder. 10. The base of the bladder. 11. The vesicula seminalis of the left side. 12. The cervix of the bladder. 13, 13. The pelvic fascia, reflected from the internal surface of the pubis and side of the pelvis upon the bladder and rectum. 14. The prostate gland. 15. A space, which is occupied by cellular tissue and a plexus of veins. 16. The deep perinæal fascia, consisting of two layers; the posterior layer is seen to be reflected backwards upon the prostate gland; the anterior layer is divided farther from the middle line, so that its reflection forwards cannot be perceived. 17. The membranous portion of the urethra, unusually short in this subject. 18. The two layers of deep perinæal fascia below the membranous portion of the urethra. 19. Cowper's gland of the left side. 20. The perinæum. 21. The superficial perinæal fascia, which is continuous with the deep fascia. 22. The anal layer of fascia, continued downwards upon the levator ani. 23. The levator ani muscle. 24. The superficial sphincter ani. 25. The prolongation of the superficial sphincter ani forwards upon the common superficial fascia. 26. The bulbous portion of the corpus spongiosum. 27. The body of the corpus spongiosum. 28. The left crus of the corpus cavernosum, divided. 29. A space in the perinæum, from which the accelerator urinæ muscle has been removed in order to see the bulb more distinctly: this space is occupied by the muscles and vessels of the perinæum. 30. The third portion of the rectum, covered by a layer of fascia derived from the pelvic fascia. 31. The second, or middle portion of the rectum: its muscular coat shown. 32. The first portion of the rectum. 33. The peritonæum, reflected from the anterior surface of the rectum upon the posterior part of the bladder. 34. The recto-vesical fold of peritonæum. 35. The reflection of the peritonæum from the fundus of the bladder, upon the internal surface of the parietes of the abdomen. 36, 36. Section of the sacrum. 37. Section of the coccyx. 38, 38. Section of the integument over the posterior surface of the sacrum.

Fig. 2. An anterior view of the urinary bladder, showing the distribution of its muscular coat.

No. 1. The prostate gland. 2. A portion of the membranous part of the urethra. 3, 3. Tendons of the bladder, or of the detrusor urinæ muscle. 4, 4. That process of the expanded tendon which is inserted into the os pubis near the symphysis. 5, 5. The inferior portion, attached to the ramus of the pubis and ischium. 6, 6. The longitudinal fibres of the detrusor urinæ, expanding laterally as they ascend the anterior surface of the bladder. 7, 7. Fibres disposed in an oblique direction. 8. The urachus, upon which some of the longitudinal fibres may be followed. 9. Decussation of the longitudinal fibres upon the neck of the bladder.

Fig. 3. A posterior view of the same urinary bladder.

No. 1. The urachus. 2, 2. The longitudinal fibres passing over the summit of the bladder to descend vertically along its posterior surface. 3, 3. Some of the longitudinal fibres thrown into an oblique position upon the sides of the bladder. 4, 4. The vesiculæ seminales. 5, 5. The vasa deferentia. 6. The triangular interval at the base of the bladder, through which the recto-vesical operation for puncturing the bladder is performed. 7, 7. The ureters, upon which some of the longitudinal fibres are traced from the bladder.

an inch behind the clitoris, and immediately above the inlet to the vagina. Its *structure* consists of a mucous lining membrane, covered by a layer of cellular tissue; these being unconnected with any dense or unyielding parts, the female urethra admits of considerable dilatation.

From the function and connections of the *male urethra*, it may be associated with the organs of generation; moreover, as it is united to other parts (the prostate and penis), its description will be more conveniently placed after theirs.

The Male Organs of Generation.—The male organs of generation are situated for the most part on the anterior surface of the pelvis, differing in this respect from the corresponding parts in the female, the greater number of which are lodged in its cavity. They consist of, 1, the testes and their excretory ducts, the prostate and Cowper's glands (considered as accessory glands), the urethra; 2, the penis.

In pursuing the physiological order, the organs should be examined as they are here enumerated; but as the urethra forms part of the urinary apparatus just treated of, we shall commence with it, premising the description of those parts of the generative system with which it is united, namely, the prostate and the penis.

The Prostate Gland (plates XXV. XXVI).—The prostate gland (prostata) has been compared to a truncated cone, compressed from above downwards; but it more nearly resembles a chestnut both in shape and size. It usually measures a little more than an inch from side to side, an inch from before backwards, and half an inch in thickness. Situated deeply in the pelvis, behind the deep perinæal fascia and beneath the arch of the pubes, the prostate will be found to enclose part of the neck of the bladder and the commencement of the urethra at their junction; the tube, however, being so placed as that two-thirds of the substance of the gland lie beneath it. The prostate is also traversed by the common seminal ducts, which pass from behind forward through its substance and open into the urethra.

It lies immediately beneath the anterior ligaments of the bladder, and rests on the middle portion of the rectum, to which it is united by means of dense cellular membrane. The posterior border is notched in the middle, and of considerable thickness; laterally it gives attachment to, or is, as it were, slung by, the anterior part of the levator ani. In consequence of their intimate connection with the rectum, the inferior surface and posterior border are readily felt by the finger introduced into the intestine. The prostate is enclosed in a fibrous cover derived from the deep perinæal fascia; this membrane is frequently very dense, and affords considerable resistance in section of the gland during the operation of lithotomy.

Lobes—structure.—It consists of three lobes, two of which, placed laterally, are of equal size; the third (a small rounded body) is connected intimately with the others, lying behind and between them. The third lobe is exposed by turning down the vesiculæ and seminal ducts, being placed between the latter and the bladder, and corresponds to the elevation described as the luette vesicale. If enlarged, the third lobe forms a projection into the neck of the bladder, which would afford impediment to the evacuation of urine or the introduction of an instrument. The term luette vesicale, or uvula vesicæ, which has the same signification, would be more fitly applied to the diseased condition indicated than to the healthy state of the part.

The tissue of the gland is resistent, of a grayish colour, and consists of a series of follicles aggregated together. These secrete a whitish ropy mucus (liquor prostaticus), which is poured from ten or twelve orifices into the urethra on each side of the veru montanum.

The Penis (plates XXVI. XXVII).—The penis, which supports the greater part of the urethra, is composed of vascular or erectile substance, occupying, as it were, three compartments, or forming three bodies, as they are termed. Of these, two are placed superiorly, one at each side of the median line (corpora cavernosa penis); the other is situated beneath the preceding, and more especially connected with the urethra, whence it is named corpus spongiosum urethræ. The entire, intimately connected one with another, are invested by integument, the peculiar disposition of which renders a special description necessary.

The *integument—prepuce.*—The skin on the pubes is supported by a thick cushion of yellow adipose matter, and studded with hairs after puberty. It is prolonged (but much altered in character, inasmuch as here it is very thin, and fat is never deposited under it) on the body of the penis, forming a complete and close investment for it, as far as the extremity of the corpora cavernosa; at this point it is continued forwards, forming a loose and unattached fold called *prepuce*, which is intended to protect the glans. The margin of the prepuce terminates in a red line, where it becomes continuous with the mucous membrane. The latter may be traced down to the corona glandis, forming a lining

for the prepuce, and thence over the glans to the orifice of the urethra, with whose lining membrane it becomes continuous. From beneath the opening of the urethra to the base of the glans, the membrane is thrown into a fold, called *frænum præputii*. These integuments derive their blood-vessels from the superficial pudic branches of the crural arteries, and from the dorsalis penis branches of the internal pudic. Their lymphatics terminate in the inguinal glands.

The *corpora cavernosa* form the principal part of the body of the penis, and necessarily determine its form and consistence. They represent longitudinal sections of two cylindrical tubes, placed laterally with regard to one another, and intimately blended along the middle line for three parts of their length, whilst at the lower part they branch out into two processes, (crura,) so that the whole resembles the letter Y reversed. The *crura* are attached to the rami of the ischia and ossa pubis, and thence ascend, converging to the fore part of the pubic symphysis, where they become united. Along the middle line a vertical septum exists, which, however, forms but a partial separation, as it presents, more particularly towards the anterior extremity, many large foramina or fissures which admit of a free communication from side to side,—from this circumstance it is named *septum pectiniforme*.

The inferior surface of the penis presents, along the middle line, a groove, which partly lodges the canal of the urethra; the anterior extremity is rounded and supports the glans, with whose base it is firmly united. The upper surface, or dorsum, is also marked, but slightly, for the dorsal vein, and is attached to the symphysis pubis by a triangular *suspensory ligament*. This is a dense lamella of fibres, so placed, that whilst the cutaneous border is free, the superior one is attached to the pubes, and the inferior to the body of the penis, where its fibres spread out, becoming identified with its structure.

Structure.—The corpora cavernosa are composed of a fibrous sheath, enclosing a quantity of erectile tissue. The exterior investment is dense, elastic, and resisting, though composed for the most part of longitudinal fibres. From the inside of its circumference thin lamellæ project, forming partial septa, by means of which the shape of the part is maintained, more than a certain degree of distension is prevented, and the cavity is divided into several small cells. Within these is enclosed the intricate vascular interlacement just alluded to, which consists of numerous ramifications of blood-vessels, chiefly veins, forming complicated anastomoses.

A transverse section of the body of the penis will show the relation and connection of its component parts. On the sides are two cylindrical tubes, formed by a fibrous membrane, enclosing a vascular mass in the interior, and divided along the middle line by a vertical septum; beneath and between these runs the urethra, surrounded by its vascular investment. The vessels and nerves of the corpora cavernosa are derived from the internal pudic.

About an inch, or a little less, from the anterior margin of the prostate, the urethra comes into contact with what is called the bulb, which is succeeded by a prolongation, similar in structure, named corpus spongiosum, and the latter finally expands into the glans penis; so that the canal is invested for three-fourths of its length by a vascular network, which, by being differently disposed in different parts, has received the names just mentioned. It consists of a minute interlacement of capillary vessels, connected together by cellular membrane, capable of receiving a considerable quantity of blood, and thereby assuming that state of tension which attends the venereal orgasm. Hence it has been termed erectile tissue.

The *bulb* is thick, and pendent from the under surface of the canal: it is placed externally to the pelvis, being in front of the deep perinæal fascia, which sends forwards on it a tubular investment. It rests on and is supported by the acceleratores urinæ, and lies immediately beneath the angle formed by the junction of the corpora cavernosa. The bulb receives a large artery from the internal pudic.

The *corpus spongiosum*, extending between the bulb and glans, surrounds the urethra, but exists in greater quantity along its lower aspect; this is partly covered by the same muscles as the preceding.

The *glans* (glans penis) forms the extremity of the penis; it is a conical prominence, slightly compressed from before backwards, presenting at its summit a vertical fissure, marking the termination of the urethra; its base is supported by the extremity of the corpora cavernosa, and presents a circular ridge (corona glandis). Behind the last-named part exists a circular constriction (cervix), in which are several follicles (glandulæ Tysoni), that secrete a substance of peculiar odour. The glans is covered by a thin dry mucous membrane, which is intimately adherent to the structure beneath it, and is continuous at the cervix with the inner layer of the prepuce, as well as with the lining membrane of the urethra at the orifice of that canal. It is also protected by the prepuce.

Urethra.—The urethra is extended from the neck of the bladder to the extremity of the penis;

its length has been very differently stated by different persons. It is usually set down as being from nine to twelve inches; but an examination of a considerable number of cases made to determine this point, gave, as the greatest length, nine inches and a half, and the least seven inches and a half.* Its diameter varies in different parts, being about four lines wide in the greater part of its extent, and from two and a half to three at its orifice.† The tube consists of two structures: one being the mucous lining, continuous with that of the bladder; the other a lamella of cellular membrane, resembling the sub-mucous tissue elsewhere, and which serves to connect it with the contiguous structures found along its course.

The urethra is considered as being divisible into three portions, which are named according to the structures that surround them, each presenting some peculiarities deserving notice.

1. The *prostatic portion* (pars prostatica) is from twelve to fifteen lines in length; it is the widest part of the canal, being, however, larger in the middle than at its extremities. In the middle of its floor, or lower surface, projects a narrow ridge, of some lines in length, formed by an elevation of the lining membrane and subjacent cellular tissue. From its shape it has received the name of *caput*

* Whately on the Treatment of Strictures.

† Sir E. Home's Practical Observations on the Treatment of Strictures in the Urethra.

PLATE XXVI.

The anatomy of the urinary bladder and urethra, and of the male organs of generation.

Fig. 1. The urinary bladder, laid open from the front in order to show the anatomy of its interior. The urethra is also exhibited throughout its entire course; the prostatic portion being opened from above, and the spongy portion from the under part of the corpus spongiosum.

No. 1. The mucous lining of the interior of the bladder. 2, 2. The divided coats of the bladder turned aside. 3, 3. The openings of the termination of the ureters. 4. The triangular smooth surface at the base of the bladder, which is called the trigone vesicale, or trigonum vesicæ. 5. The projection of the mucous membrane at the commencement of the urethra, which is called the uvula vesicæ. 6, 6. The neck of the bladder. 7, 7. The prostate gland. 8, 8. The divided surfaces of the prostate, resulting from the incision which has been made to show the prostatic portion of the urethra. 9, 9. The prostatic portion of the urethra. 10. The veru montanum, or caput gallinaginis. 11, 11. The openings of the ejaculatory ducts; an aperture between these openings leads into the sinus pocularis. 12, 12. The prostatic sinuses, in which are seen the numerous openings of the prostatic ducts. 13, 13. The membranous portion of the urethra; it has been divided across in order to show the rest of the urethra from the under part of the corpus spongiosum. A small part of this portion of the urethra has been removed. 14, 14. Cowper's glands. 15, 15. The ducts of these glands traced for some distance between the corpus spongiosum and the coats of the urethra previously to opening into that canal. 16, 16. The bulb of the urethra, divided by a longitudinal incision; the erectile tissue shown. 17, 17. The body of the corpus spongiosum divided. 18, 18. The corpus cavernosum. 19, 19. The glans penis. 20. The bulbous portion of the urethra. 21. The dilatation called the fossa navicularis. 22, 22. The openings of small mucous lacunæ upon the upper wall of the urethra. 23. The opening of the lacuna magna.

Fig. 2. The interior of the urinary bladder and urethra, shown by means of a vertical incision in the longitudinal direction.

No. 1. The interior of the body of the bladder. 2. Its fundus. 3. Its base. 4, 4. The neck. 5. The recto-vesical fold of the peritonæum. 6. The urachus, the point of reflection of the peritonæum upon the internal surface of the abdominal parietes. 7. The trigonum vesicæ. 8. The opening of entrance of the ureter of the right side. 9. The uvula vesicæ. 10, 10. The prostate gland. 11. The third lobe, or isthmus of the prostate gland. 12. The vesicula seminalis of the left side. 13. The ejaculatory duct passing beneath the isthmus, or third lobe of the prostate, to open into the prostatic portion of the urethra. 14. The veru montanum, or caput gallinaginis. 15. The prostatic portion of the urethra. 16. The membranous portion. 17. One of Cowper's glands, with its excretory duct. 18, 18. The corpus cavernosum, divided a little to the left of the middle line. 19. A part of the septum pectiniforme. 20. The bulb of the corpus spongiosum. 21. The body of the corpus spongiosum. 22, 22. The glans penis. 23. The bulbous portion of the urethra. 24. The fossa navicularis of the urethra. 25. The meatus urinarius. 26, 26. The openings of mucous lacunæ. 27. The line of junction between the corpus cavernosum and glans penis.

Fig. 3. The under surface of the base of the bladder, with the vesiculæ seminales in their relative position.

No. 1. The recto-vesical fold of peritonæum, removed from the anterior surface of the rectum and sacrum, and raised for a short distance from the base of the bladder, and folded back upon that organ. 2, 2. The vasa deferentia. 3, 3. The vesiculæ seminales. 4. The triangular space upon the exterior of the base of the bladder, through which the recto-vesical operation for puncture of the bladder is performed. 5, 5. The ureters. 6. The prostate gland. 7. The commencement of the membranous part of the urethra.

Fig. 4. The vesiculæ seminales turned back from the base of the bladder, in order to show the passage of the ejaculatory ducts beneath the isthmus of the prostate gland.

No. 1. A portion of the bladder turned up from the prostate gland. 2, 2. The lateral lobes of the prostate. 3. Its third lobe or isthmus. 4, 4. The vesiculæ seminales. 5, 5. The vasa deferentia. 6. The ejaculatory ducts.

Plate 26.

Fig. 1.

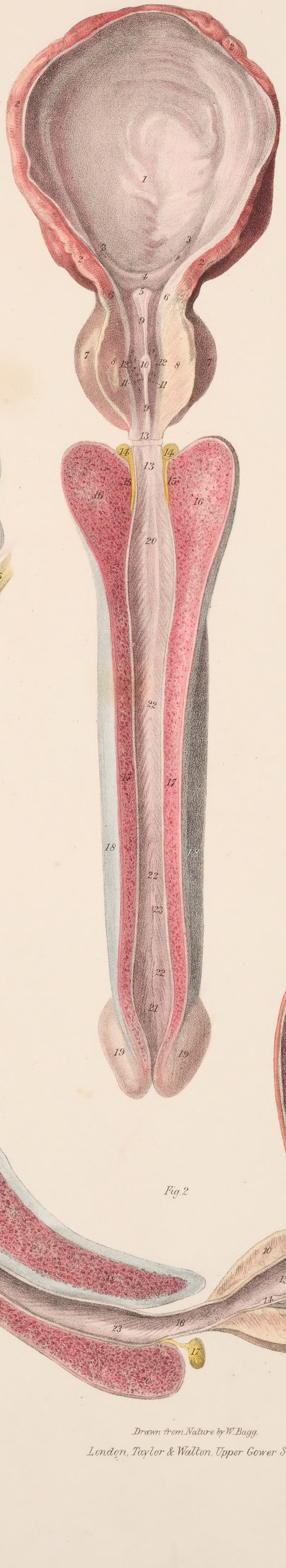


Fig. 3.

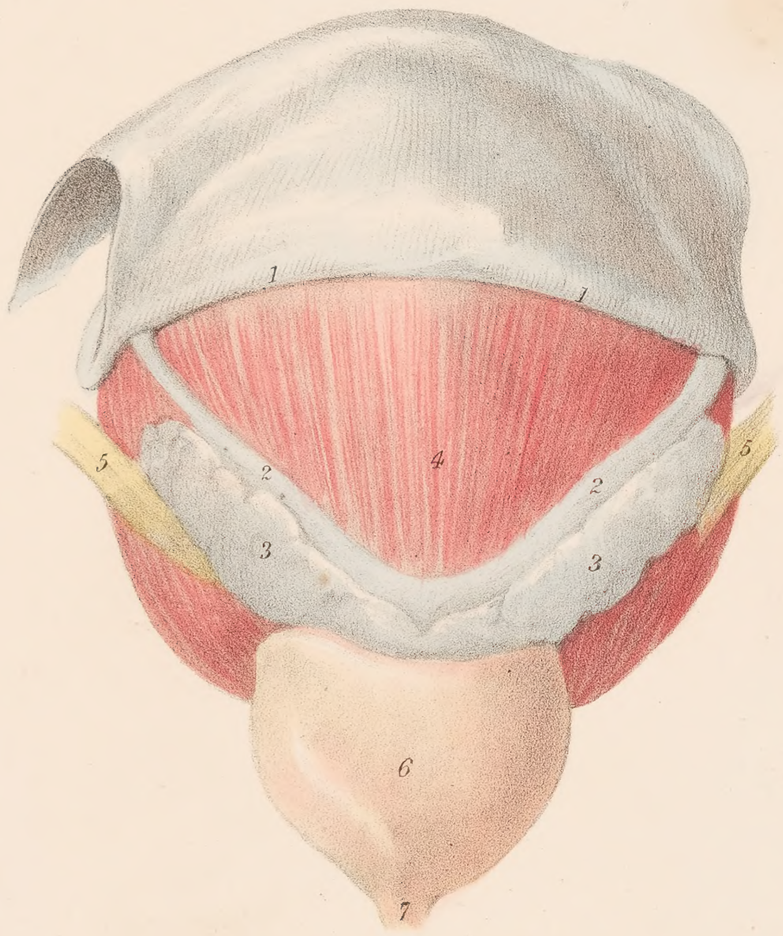


Fig. 4.

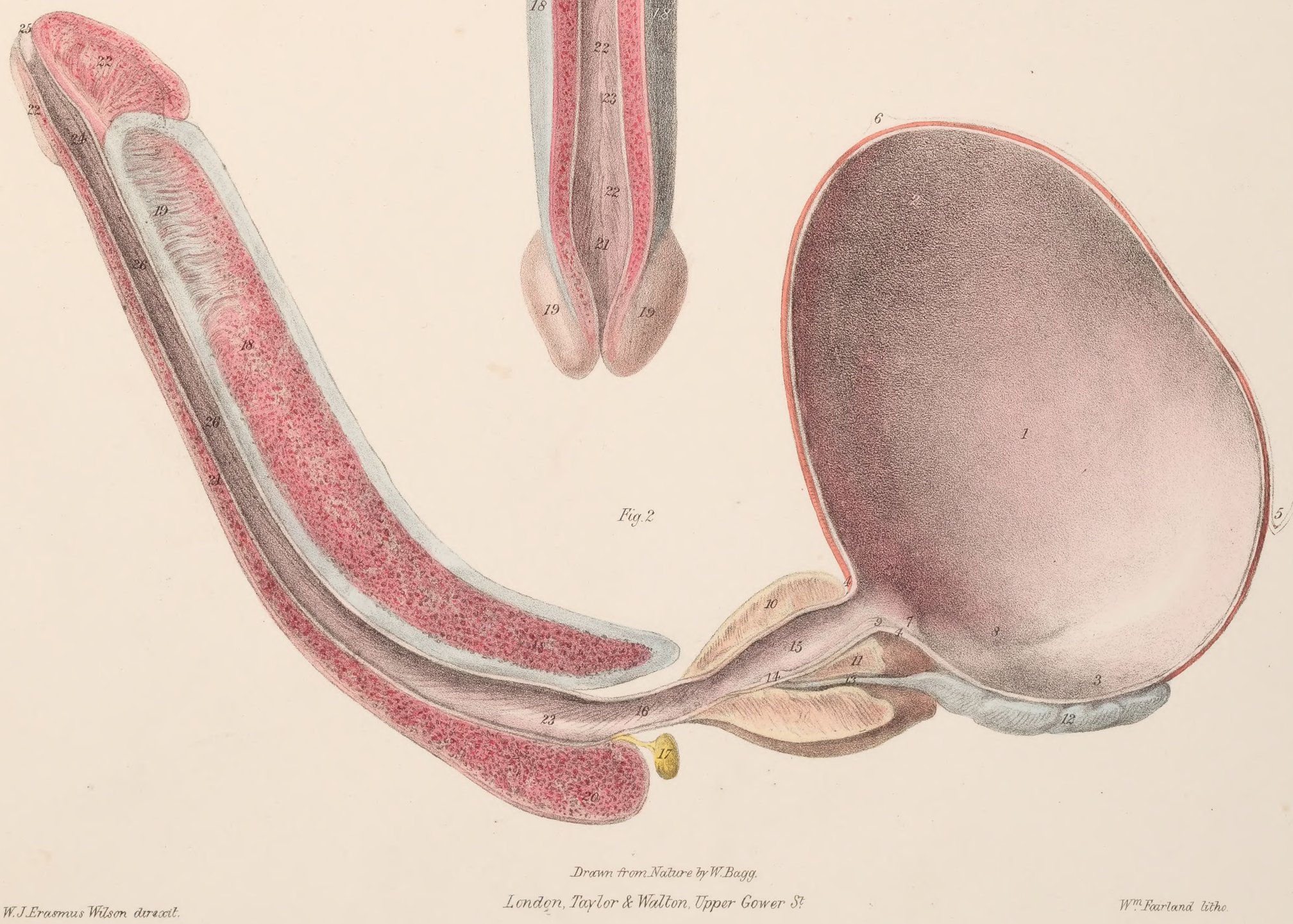


Fig. 2

Drawn from Nature by W. Bagg.

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W. J. Erasmus Wilson direxit.

Wm. Fairland litho.

Plate 27.

Fig.1.

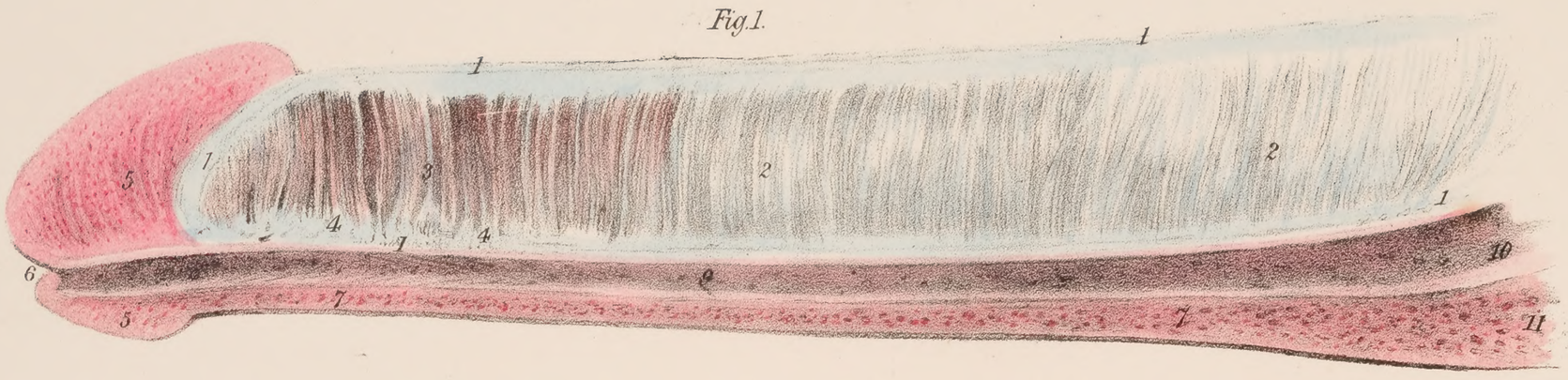

Fig.2.

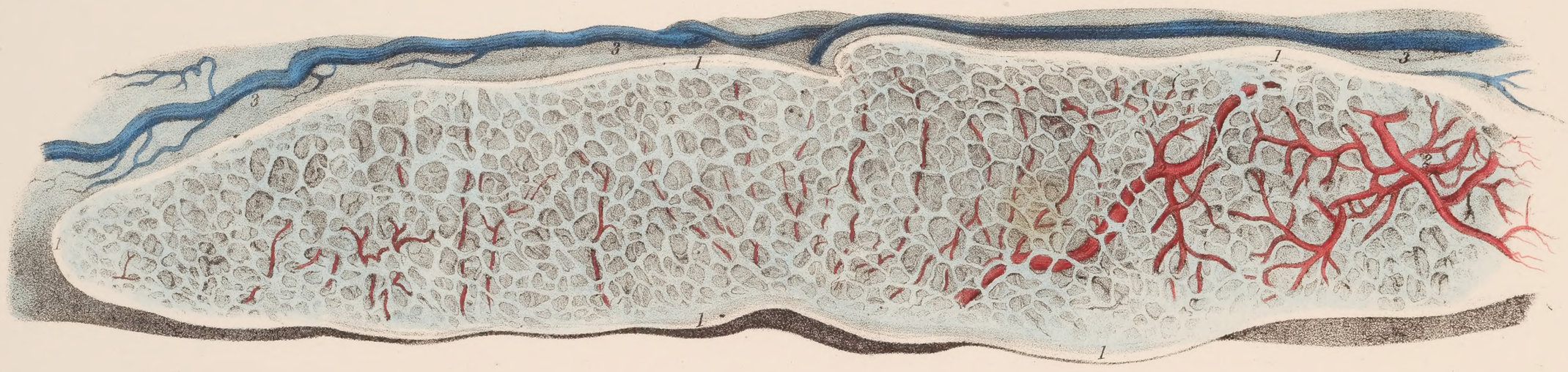

Fig.3

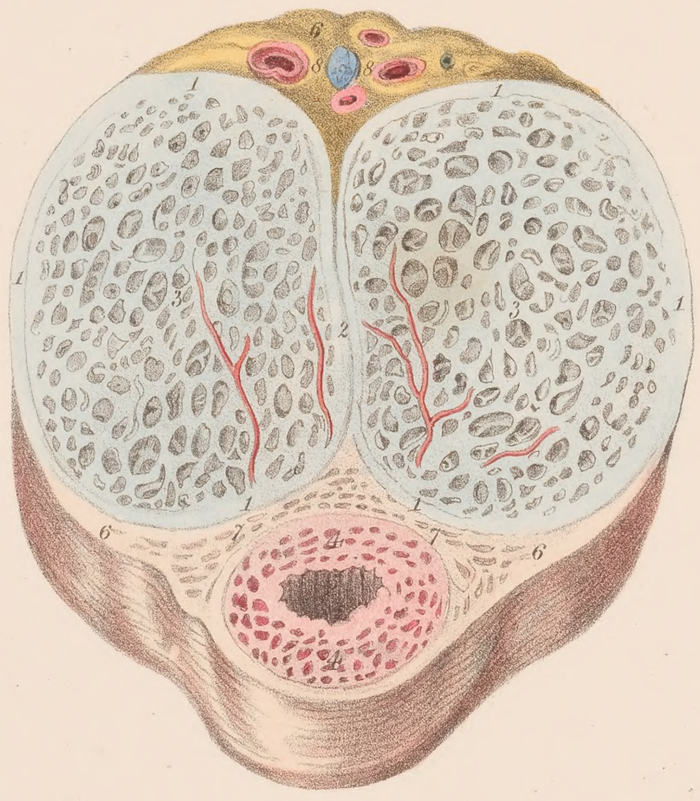

Fig.4

Fig.5.

Fig.6.

W.J.Erasmus Wilson direxit

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The skin is of a darker colour than elsewhere; it is also thrown into several rugæ or folds, and marked along the middle line by a slightly elevated ridge or raphé, extending from the penis along the centre of the perinæum to the margin of the anus. It is furnished with several sebaceous follicles and some scattered hairs, the bulbs of which are distinctly perceptible when the scrotum is elongated.

The *dartos* is a thin lamella of a peculiar texture, placed beneath the skin, and so disposed as to form two sacs, each containing the testis of the corresponding side, and both united along the median line,—thus forming a partition between them (*septum scroti*). This structure is vascular, and striated so as to resemble in some degree muscular fibre. It is confessedly contractile, and serves the purpose of drawing up and sustaining the testes, at the same time that it corrugates the skin; but when macerated, or tried by the usual tests, no trace of fibrine can be discovered in it. When examined with attention, it will be found that its texture gradually becomes assimilated to the superficial fascia which descends from the abdomen round the cord, and again, below the scrotum, it in the same way passes into the superficial fascia of that region. We may now call to our aid a few facts, which will assist in throwing some light upon, if they do not actually determine, a litigated question. That lamella which lies between the skin and abdominal muscles in the human subject is merely cellular membrane; in the larger quadrupeds a layer of elastic tissue (tissu jaune) is substituted, in order to support the weight of the viscera. In the human subject such a support is not wanted for the abdomen, but the pendulous testes require something of the kind. When emaciation occurs, indicating a general diminution in the subcutaneous cellular deposit, the testes hang lower than they had previously done, owing to the absorption of the elastic tissue of the dartos, and its consequent conversion into mere cellular membrane; but when the *embonpoint* is restored, the testes rise to their usual level, by the restoration of the sustaining agent. In this view of the subject the dartos constitutes a transition structure between cellular membrane and elastic tissue.

Fascia of the Cord, Cremaster, &c.—Beneath the dartos lies the thin fibrous expansion derived from the external abdominal ring; it is connected with that next in order. The cremaster, named also from its colour tunica erythroides (ερυθρος, red; ειδος), consists of muscular fibres arching downwards in front of the cord and testes, some being also placed behind. The fibres of the cremaster, where they are distinct one from the other (intervals existing between them), are connected by cellular tissue. Under the preceding is found a thin cellular investment, which is continued from the fascia transversalis at the internal abdominal ring. The three laminæ here described, namely, that given from the margin of the external ring, the cremaster, and the process derived from the fascia transversalis, are common to the spermatic cord and the testis; on the latter they are closely united one to the other, and to its serous tunic.

Vessels and nerves.—The investments of the cord and testes are supplied with blood from three sources. 1. The external pudic artery passes inwards from the femoral, and crossing the cord, distributes branches to the anterior and lateral parts of the scrotum, as well as to the integuments of the penis and pubes. 2. More deeply seated than the preceding is situated a branch given from the epigastric artery. This supplies the cremaster, from which it is named *ramus cremastericus*, and sends ramifications to the integument of the scrotum and pubes. 3. The perinæal branch of the internal pudic proceeds along the perinæum, from behind forward to the scrotum, in which it is distributed, especially towards the septum.

The *veins*, owing to the thinness of the skin of the scrotum, are apparent on the surface; they follow the course of the arteries. The lymphatics for the most part open into the inguinal lymphatic glands.

The *nerves*, like the arteries, are three in number. One, the ilio-scrotal, proceeding from the musculo-cutaneous branch of the lumbar plexus, passes out of the external abdominal ring, and divides into filaments, which supply the integument of the scrotum. In some cases two small branches are found to follow the course here pointed out. 2. The genito-crural proceeds also from the lumbar plexus. As its name implies, this nerve, dividing, sends one part to the integuments of the thigh, the other comes into contact with the spermatic cord at the internal abdominal ring. This latter, passing through the inguinal canal, sends many filaments to the cremaster, while others are given generally to the covers of the cord and testis. The third is the perinæal nerve. It accompanies the artery of the same name, and ramifies in the inferior and lateral parts of the scrotum.

Tunica vaginalis.—Under the parts described as forming investments common to the cord and the testis, lies the proper serous covering (*tunica vaginalis*) of the latter (plate XXVIII). The manner in which this membrane is derived from the peritonæum, and the changes which occur subsequently

dilatation appears to take place, called *fossa navicularis*, previously to its narrowing into the orifice of the urethra. It has been contended by M. Amussat, that this dilatation is rather apparent than real, and that it is owing to the fact that the glans, by its greater firmness of texture, draws the lining membrane outwards with it when the urethra is laid open, thereby making it appear wider than it is in reality.

Lining membrane.—Lacunæ.—The lining membrane is smooth and lubricated, as mucous surfaces usually are. Several minute foramina will be found to open into it, being the orifices of mucous follicles, or cryptæ, placed exterior to the mucous membrane, but lined by delicate processes prolonged from it into their interior. These are named *lacunæ;* they are inclined from behind forward, so that urine, when being evacuated, does not find ingress to them.

Cowper's Glands.—These are two small masses, about the size and shape of peas, placed immediately beneath the membranous part of the urethra, and behind the bulb. They consist of several small lobules, united by a membranous investment. Two ducts, from three quarters of an inch to an inch long, issue from them, and proceed forwards, to open into the urethra a little before the bulb. They are retained *in situ*, and supported, by a tubular prolongation sent forwards on the urethra from the deep perinæal fascia. The existence of Cowper's glands is not constant. In front of them a single small granule or glandular body is occasionally found.

The Testes;—their change of situation,—descent (*?*).—The testicles, (διδυμοι, *testes*,) the secreting organs of the seminal fluid, lie, in the earlier months of fœtal life, on the psoas muscles, near the lower extremities of the kidneys. Each of them is invested by a proper capsule, or fibrous tunic, and receives, moreover, a partial covering from the peritonæum, to about the same extent as the kidney does, as both are similarly circumstanced with regard to that membrane. It receives its artery from the aorta, close to which it lies, whilst the vein opens into the vena cava on the right side, and into the renal vein on the left. From the lower extremity its duct (vas deferens) will be observed to descend towards the neck of the bladder.

Gubernaculum testis.—From the lower end of the testis a cellulo-fibrous cord, of a very different character from that just mentioned, is extended down through the inguinal canal, to the external surface of the pubic symphysis. This has been called by Mr. Hunter gubernaculum testis; it appears a little broader above than below, and also to contain a minute canal.

In the seventh month of pregnancy the length of the gubernaculum is considerably diminished, as the testis has changed its place, having removed from the lumbar region to the iliac fossa. This in strictness cannot be considered a "descent:" for, in the ordinary position of the fœtus, the change is the reverse of that in which its gravity would draw it, and therefore it is rather an ascent. In the eighth month, the testis enters the internal ring, lying behind a process of peritonæum, which makes its exit from the abdomen by the inguinal canal; and at the ninth month it will be found at the bottom of the scrotum, bearing the same relation to its peritonæal investment that it had originally done to the whole membrane, that is to say, lying behind and exterior to its cavity, but still partially covered by it.

The process of peritonæum that accompanies the testis in its course from the lumbar region to the scrotum, is an elongated cul-de-sac, somewhat like the finger of a glove, communicating at the inguinal ring with the general cavity of that membrane, and resting on the fore part of the testis and its cord, but closely adherent to both. By degrees its aperture is closed by the narrowing of the ring, and all communication with the abdomen is cut off; after which the part of the process which corresponds with the cord degenerates into cellular tissue, whilst that over the testis remains still a serous cavity. The position and relation of this organ to its serous investment may be illustrated by taking a small bladder, and pressing some elongated body, such as an almond, against its side, so as partially to invest it, the invested portion being made to serve as an immediate though partial covering for the substance so placed, as a part must remain unconcealed along the lines of reflection. This is the way in which the *tunica vaginalis* is derived from the peritonæum, and the position in which the testis is placed with regard to it.

Coverings of the Testis and Cord.—Whilst passing through the inguinal canal, the testis and cord become covered by offsets from the abdominal muscles; exterior to which lie the superficial fascia and the integument. These structures we shall now consider as they are found in the adult.

Scrotum.—The testes are contained in a cul-de-sac, or purse-like investment (scrotum), which is short and corrugated in cold weather and in robust persons, but becomes elongated and flaccid in the opposite circumstances. The covering of the testes being composed of several strata, differing in structure, each requires separate examination.

The skin is of a darker colour than elsewhere; it is also thrown into several rugæ or folds, and marked along the middle line by a slightly elevated ridge or raphé, extending from the penis along the centre of the perinæum to the margin of the anus. It is furnished with several sebaceous follicles and some scattered hairs, the bulbs of which are distinctly perceptible when the scrotum is elongated.

The *dartos* is a thin lamella of a peculiar texture, placed beneath the skin, and so disposed as to form two sacs, each containing the testis of the corresponding side, and both united along the median line,—thus forming a partition between them (*septum scroti*). This structure is vascular, and striated so as to resemble in some degree muscular fibre. It is confessedly contractile, and serves the purpose of drawing up and sustaining the testes, at the same time that it corrugates the skin; but when macerated, or tried by the usual tests, no trace of fibrine can be discovered in it. When examined with attention, it will be found that its texture gradually becomes assimilated to the superficial fascia which descends from the abdomen round the cord, and again, below the scrotum, it in the same way passes into the superficial fascia of that region. We may now call to our aid a few facts, which will assist in throwing some light upon, if they do not actually determine, a litigated question. That lamella which lies between the skin and abdominal muscles in the human subject is merely cellular membrane; in the larger quadrupeds a layer of elastic tissue (tissu jaune) is substituted, in order to support the weight of the viscera. In the human subject such a support is not wanted for the abdomen, but the pendulous testes require something of the kind. When emaciation occurs, indicating a general diminution in the subcutaneous cellular deposit, the testes hang lower than they had previously done, owing to the absorption of the elastic tissue of the dartos, and its consequent conversion into mere cellular membrane; but when the *embonpoint* is restored, the testes rise to their usual level, by the restoration of the sustaining agent. In this view of the subject the dartos constitutes a transition structure between cellular membrane and elastic tissue.

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Tunica vaginalis.—Under the parts described as forming investments common to the cord and the testis, lies the proper serous covering (*tunica vaginalis*) of the latter (plate XXVIII). The manner in which this membrane is derived from the peritonæum, and the changes which occur subsequently

to its being drawn down from the abdomen into the scrotum, have been already described. In the adult it forms a shut sac, inverted on itself in such a way as that one part of it covers the body of the testis, as well as the epididymis, except where the vessels enter its posterior border; at which point the other part is reflected outwards, and becomes a lining to the preceding investments, to which it is closely adherent. From the difference in the disposition or relations of both these parts of the membrane, they generally receive different names. One (that adherent to the testis) is called *tunica vaginalis testis*, the other is named *tunica vaginalis reflexa*.

The Testes,—their disposition and structure.—Having considered their change of position, and examined the various structures by which they are invested, we now proceed to the description of the organs themselves.

The testes (plates XXVIII. and XXIX.) are suspended at unequal heights, that of the right side being higher than the opposite; this disposition prevents the inconvenience or injury that might result from one being pressed against the other in certain positions of the thighs. They are of an oval form, somewhat compressed laterally, and so placed by the manner in which they are suspended by the spermatic cords, that their upper extremities are turned obliquely forwards, and the lower in a corresponding degree backwards. The long diameter of each varies from an inch and a half to two

PLATE XXVIII.

Anatomy of the male organs of generation.

Fig. 1. The peculiar distribution of the arteries of the penis, supposed by Müller to produce the erection of the organ. This figure exhibits the arteriæ helicinæ in a magnified portion of the corpus cavernosum penis.—From Müller's Archiv. for 1835.

Nos. 1, 1. The cellular structure of the corpus cavernosum. 2, 2. Branches of the artery of the corpus cavernosum, taking their course in the substance of the walls of the cells. 3, 3. Nutritious twigs of the artery of the corpus cavernosum, which terminate in capillaries continuous with the veins. 4, 4. Helicine arteries, terminating in a tuft (Quast) of club-shaped and tendril-like twigs, curved like horns at their extremities. This tuft is inclosed in an elastic membrane, and projects into one of the venous cells of the erectile tissue. 5, 5. Helicine arteries, terminating in a single twig.

Fig. 2. A single tuft of a helicine artery, projecting into one of the venous cells.

Fig. 3. A magnified view of a portion of injected corpus cavernosum penis, showing the communication of the venous cells with the dorsalis penis vein.

No. 1. The venous cells of the periphery of the corpus cavernosum. 2, 2. Small veins, collecting the returning blood from the venous cells. 3. The dorsalis penis vein.

Fig. 4. Distribution of nervous filaments to the cellular texture of the corpus cavernosum, in company with a branch of the artery of the corpus cavernosum.—The four preceding figures are copied from Müller's Archiv. for 1835.

Fig. 5. A testis, with a portion of the spermatic cord; the tunica vaginalis is laid open in order to show the body of the gland and the epididymis.

No. 1. The spermatic cord. 2, 2. The tunica vaginalis reflexa. 3. The testis, invested by the tunica vaginalis propria. 4. The epididymis. 5. The globus major of the epididymis.

Fig. 6. A diagram representing a longitudinal section of the testis, and showing the mode of reflection of the tunica vaginalis.

No. 1. The spermatic cord. 2, 2. A section of the substance of the testis, showing its internal texture. 3. Section of the epididymis. 4, 4. The tunica vaginalis reflexa. 5, 5. The tunica vaginalis propria, investing the testis and epididymis. 6. The cavity of the tunica vaginalis.

Fig. 7. A transverse section of the testis, showing the reflection of the tunica vaginalis. The references are the same as in the preceding figure.

Nos. 7, 7. The tunica albuginea. 8. The inflection of the tunica albuginea, forming the mediastinum testis. 9. The vessels of the testis, situated in the posterior part of the mediastinum. 10. The divided tubes of the rete testis. 11. The fibrous cords or ligaments of the tunica albuginea. 12, 12. The lobular structure of the testis.

Fig. 8. The "tunica albuginea, cut perpendicularly through its centre."—The two last figures are copied from Sir Astley Cooper's beautiful monograph "On the Structure and Diseases of the Testis."

Nos. 1, 1. The mediastinum testis. 2, 2. The fibrous cords or "ligaments which connect the sides of the tunica albuginea, and which form strong bands of union between them, to prevent the injurious effects of violence. Between these pillars are seen ligaments, which are shorter and more delicate, some of which proceed from the mediastinum, and a few from the opposite edge of the testis, from which membranes are extended to envelope the lobes of the tubuli."—Sir Astley Cooper's description, Op. cit.

Fig. 9. The spermatic cord, in which the vessels are successfully injected.

No. 1. The spermatic artery. 2. The deferential artery, accompanying the vas deferens. 3, 3. The vas deferens. 4. The globus minor of the epididymis. 5. The globus major of the epididymis. 6. The body of the testis. 7. The cremasteric artery. 8, 8. Spermatic veins. 9, 9. Small convoluted ramuscules of the spermatic veins, called "vasa pampiniformia."

Plate 28.

Fig.1

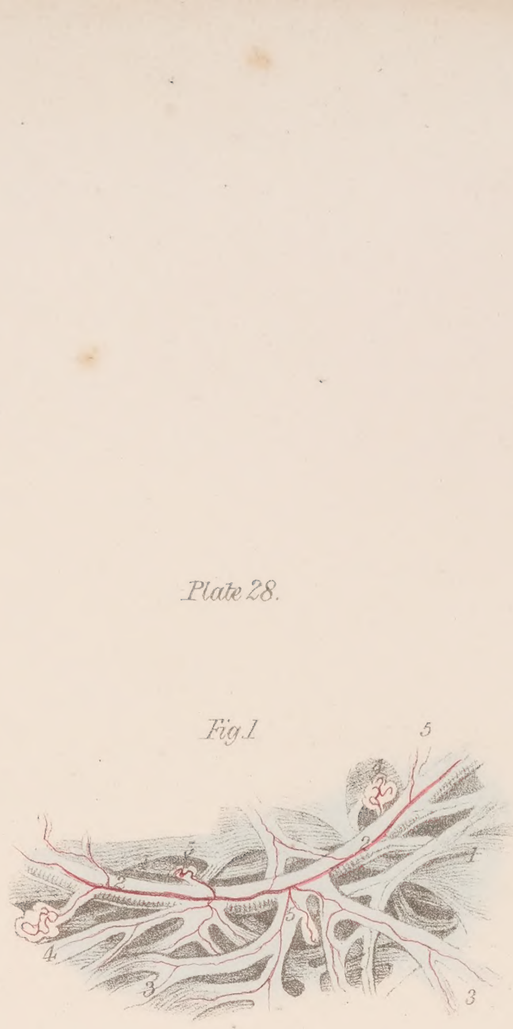

Fig.3.

Fig.2.

Fig.4

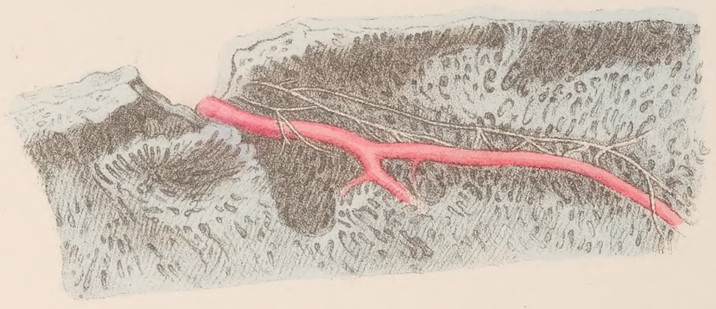

Fig.5.

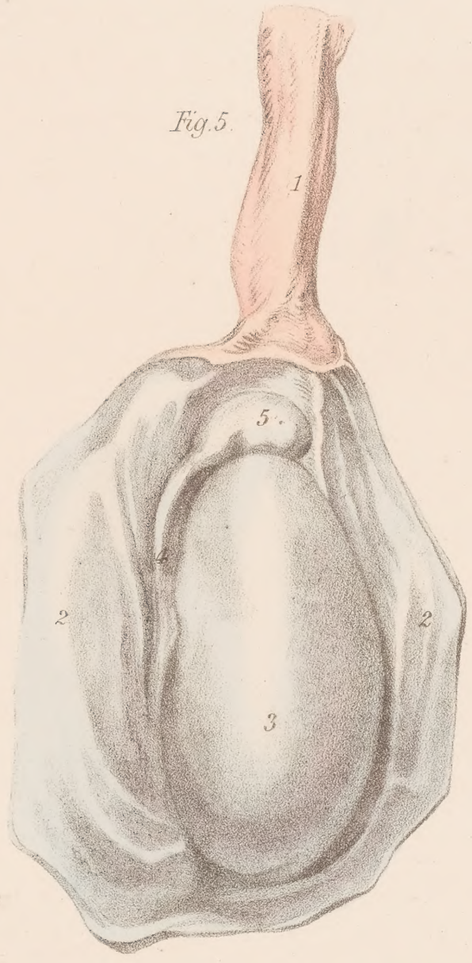

Fig.9.

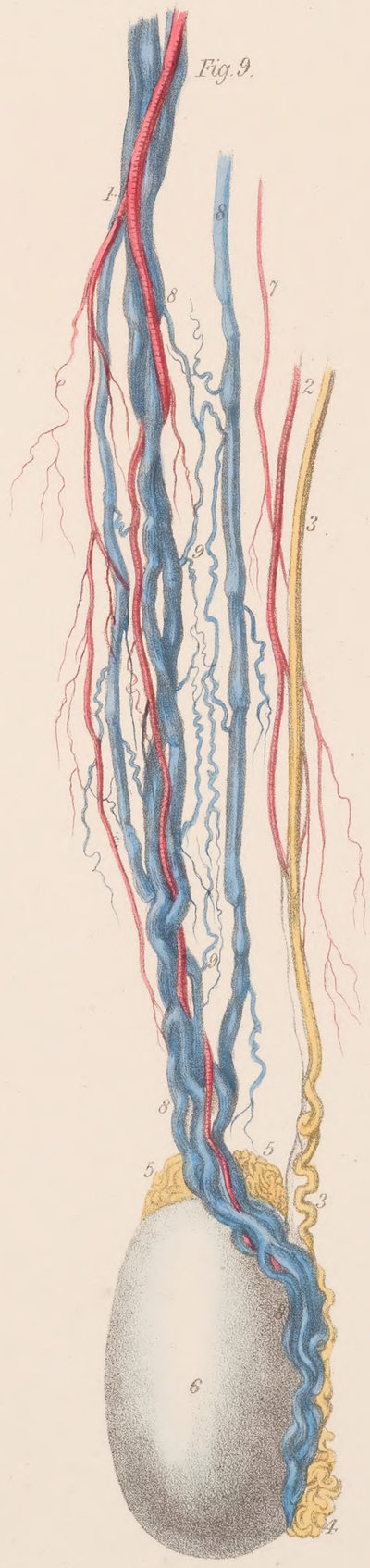

Fig.6

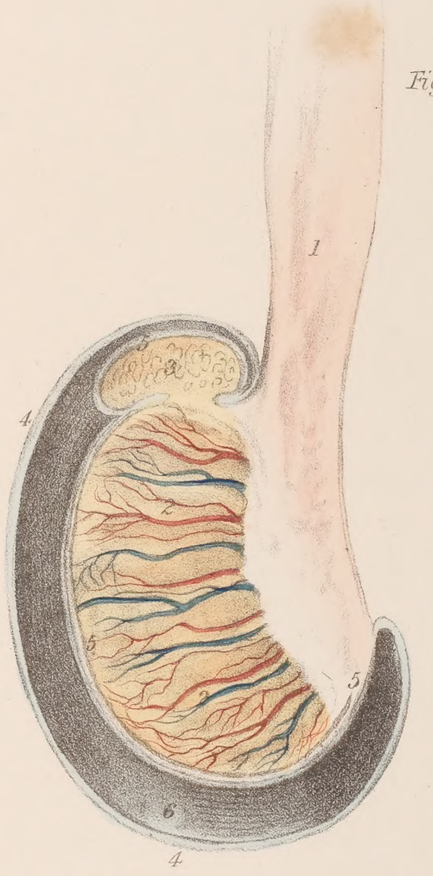

Fig.7.

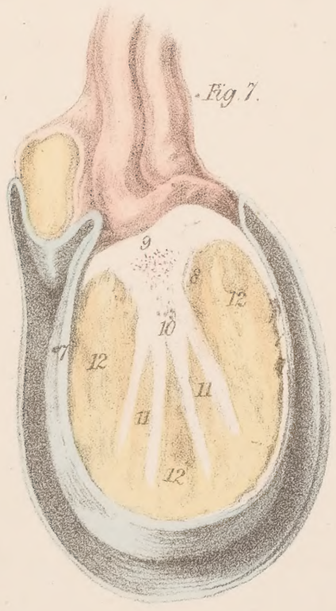

Fig.8.

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Plate 29

Fig 8.

Fig 1.

Fig. 2.

Fig 3.

Fig. 4.

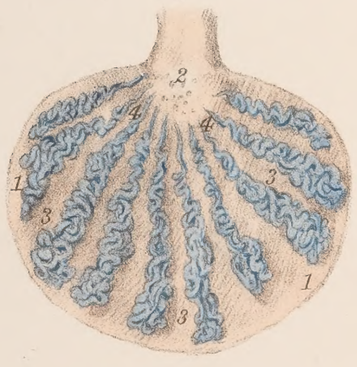

Fig. 5.

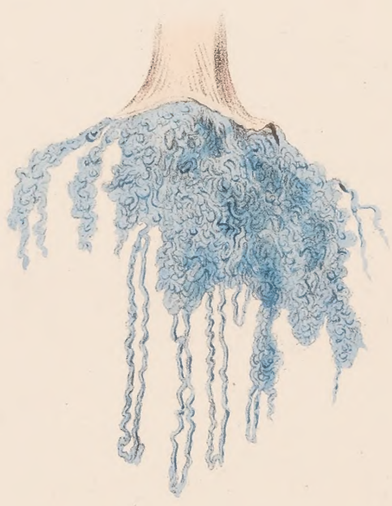

Fig. 6.

Fig. 7.

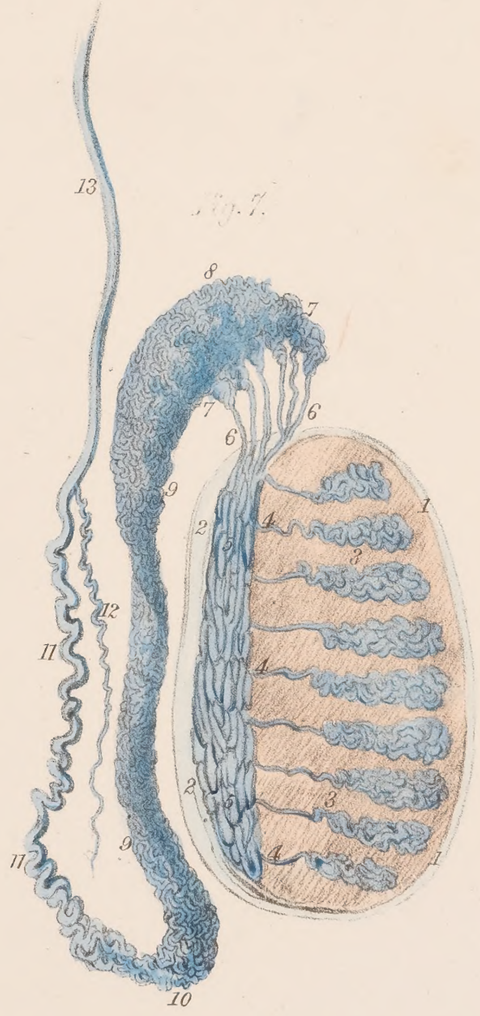

Fig. 9.

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W.J. Erasmus Wilson direxit *London, Taylor & Walton, Upper G[illegible]* *Wm Fairland litho.*

inches; that from side to side is about an inch or a little more. Along the posterior border is placed an elongated appendage, called epididymis. The secretory structure of the testis is enclosed in a firm capsule named the tunica albuginea.

Tunica albuginea.—This membrane immediately invests the substance of the testicle, and at the same time determines its form. It is of a clear white colour, dense and fibrous,—its fibres interlacing in every direction. Its outer surface is covered by the tunica vaginalis, except posteriorly, where the spermatic vessels pass through it, at which point that membrane is reflected off.

At the posterior border of the testis the tunica albuginea separates into two laminæ; one of which, the external, is continued to the vas deferens (the excretory duct of the testis); the other, joining with a corresponding layer from the opposite side, is directed for the space of a few lines into the substance of the gland. This last part, known by the name *corpus Highmorianum*, forms an incomplete septum in the cavity of the tunica albuginea, and is thence named by Sir A. Cooper* "mediastinum testis." Thus projecting from behind forwards, it is broader superiorly than at its lower extremity, and extends from the upper nearly to the lower end of the testis. Between the fibres of the mediastinum small intervals exist, which lodge seminal canals and blood-vessels, to be afterwards described. From its surface (which looks towards the cavity of the tunica albuginea) are

* Observations on the Structure and Diseases of the Testis.

PLATE XXIX.

Anatomy of the testis, with its descent in the fœtus.

Fig. 1. A transverse section of the testis, showing the membranous septa which inclose and separate the lobules of the testis.—From Sir Astley Cooper's beautiful monograph.

Nos. 1, 1. The tunica albuginea. 2. A thin membranous layer derived from the tunica albuginea, and investing the epididymis and vessels of the testis. 3. The vessels of the testis. 4. The mediastinum testis. 5, 5. Fibrous bands given off from the mediastinum, and attached by their extremity to the internal surface of the tunica albuginea. 6, 6. Niches formed by membranous septa, serving to lodge the lobules of the testis. 7, 7. Two of the lobules invested with the tunica vasculosa testis.

Fig. 2. The testis viewed from the side: a part of the tunica albuginea has been removed in order to show the lobules, inclosed in the thin expansion of the tunica vasculosa.—Atfer Sir Astley Cooper.

Nos. 1, 1. The tunica vaginalis. 2, 2. The tunica albuginea. 3. A part of the mediastinum testis. 4, 4. The lobuli testis invested by the tunica vasculosa, in which the peculiar arrangement of the vessels will be observed.

Fig. 3. A longitudinal section of the testis, showing the disposition of the lobules, with their connection to the mediastinum.—After Sir Astley Cooper.

No. 1. The lower part of the spermatic cord. 2. The globus major of the epididymis. 3. The globus minor of the epididymis; the body of the epididymis is concealed by the testis. 4, 4. The tunica albuginea. 5, 5. The mediastinum testis. 6, 6. Lobules of the testis, invested by the tunica vasculosa.

Fig. 4. A transverse section of the testis, showing the tubuli composing the lobules injected with mercury.—From one of Sir Astley Cooper's beautiful preparations.

Nos. 1, 1. The tunica albuginea. 2. The mediastinum: the dark points upon the surface represent the extremities of the rete testis by which the tubuli have been filled with the injection. 3, 3. The lobuli testis, seen to be composed of the convolutions of minute tubes, the tubuli seminiferi. 4, 4. The vasa recta.

Fig. 5. A very beautiful preparation, made by Sir Astley Cooper, in which the tubuli are filled with size injection, and unravelled.

Fig. 6. The substance of the testis, as seen upon the removal of the tunica albuginea and tunica vasculosa.—After Sir Astley Cooper.

Nos. 1, 1. The flattened extremities of the lobuli testis.

Fig. 7. The secreting and excreting structure of the testis.—From a preparation injected with mercury and dried.

Nos. 1, 1. The tunica albuginea. 2, 2. The mediastinum testis. 3, 3. Lobules of the testis, composed of the convolutions of the tubuli seminiferi. 4, 4. Vasa recta. 5, 5. The rete testis. 6, 6. Vasa efferentia. 7, 7. Cones of tubuli formed by the vasa efferentia, and called coni vasculosi. 8. The mass of tubuli at the upper extremity of the organ constitutes the globus major of the epididymis. 9, 9. The body of the epididymis. 10. The globus minor of the epididymis. 11, 11. The convoluted commencement of the vas deferens. 12. The vasculum aberrans, terminating in the commencement of the vas deferens. 13. The vas deferens.

Fig. 8. A diagram section of the scrotum of a fœtus, representing the descent of the testis.

No. 1. The gubernaculum testis. 2. The testis. 3, 3. The peritonæum, being carried down into the scrotum by the testis.

Fig. 9. A more advanced stage in the descent of the testis, after it has completely descended, but previously to the closure of the tunica vaginalis.

No. 1. The testis. 2. The spermatic cord. 3, 3. The peritonæum. 4, 4. The cavity of the tunica vaginalis communicating with the cavity of the peritonæum: this is the condition of parts previously to the occurrence of congenital inguinal hernia.

given off fibrous processes that admit of being distinguished into two series. One of these consists of several slender cords or filaments, which, being also connected to the tunica albuginea at different points, serve to maintain the shape of the testis. The others, in the form of delicate laminæ, separate and support the several lobules into which the seminal vessels are divided.

Tunica vasculosa.—The inner surface of the tunica albuginea is lined by a delicate membrane formed of the ultimate ramifications of the spermatic blood-vessels, united by a minute portion of cellular tissue, and hence named tunica vasculosa.* This vascular membrane is also expanded over the fibrous processes already pointed out, and is thus brought into relation with each lobule of the testis.

The tunica albuginea being removed, the *glandular structure* of the testis lies exposed. It has the appearance of a soft, pulpy, dark yellow mass, divided into lobes. This substance is, by injection, found to consist of vast numbers of minute tubes (tubuli seminiferi) which do not communicate one with the other. The lobes (*lobuli testis*) differ in size, some containing one, others a greater number of the seminal tubes. Their shape is somewhat conical; the large end of each is directed towards the circumference of the testis, the small one towards the mediastinum. They are supported by the fibrous expansions extended from the mediastinum to the tunica albuginea.

The *tubuli seminiferi* (vascula serpentina) are the vessels in which the seminal fluid is secreted. According to Monro, their number is about three hundred, the length of each about sixteen feet, and the diameter $\frac{1}{200}$ of an inch. Each of these small vessels commences by a closed extremity towards the inner surface of the fibrous covering of the testis, and from this point proceeds, inclining from side to side in a serpentine or zig-zag course, towards the mediastinum. It loses the convoluted disposition as it approaches that process, and, passing through its fibres, opens into the next order of vessels.

Vasa recta.—The second order of seminal vessels are situated in the substance of the tunica albuginea, or rather amid the fibres of that process of it which has been termed mediastinum; of this they occupy but the anterior part, the posterior lodging the blood-vessels. The aggregate of them is named *rete testis*. Being less convoluted than the tubuli, though not straight, these vessels are named *vasa recta*. Their direction is backwards and upwards, to reach the posterior and upper part of the testis. The vasa recta are fewer in number, and larger than the tubuli seminiferi, from which they receive the secretion; and, on the other hand, are more numerous and smaller than the vessels into which they discharge it.

Vasa efferentia.—The two preceding series of canals form, with the membrane in which they are contained, what is properly called the body of the testis; they next transmit the seminal fluid from it, (to its appendage, the epididymis,) and are in consequence named *vasa efferentia:* they are from twelve to fifteen in number, and open separately into a single vessel, of which the epididymis is formed. Being straight at the point at which they leave the testis, and very much convoluted towards their other extremity, they present a conical disposition, from which the name *coni vasculosi* has been applied to them.

The *epididymis* (επι, upon; διδυμος, testis) is placed along the posterior border of the testis, and is partially invested by the tunica vaginalis. Its upper or larger extremity is called the head or globus major; the lower is named its cauda or globus minor; and the narrow intervening part, the body. The epididymis consists of a single tube much convoluted, the several convolutions being united one to the other by small fibrous bands; the larger size of the upper part is owing to its connexion with the vasa efferentia. The seminal canal at the globus minor assumes the name of vas deferens.

Vas deferens.—This is the excretory duct of the testis; there are therefore two, one on each side. The tortuous condition, so well marked in the epididymis, gradually diminishes, and is entirely lost at a short distance from the commencement of the vas deferens. Each extends from the lower border of the epididymis to the prostatic part of the urethra, passing through the abdominal parietes; its length is very considerable, and its course necessarily complicated. Ascending behind the testes, the vas deferens comes into relation with the spermatic artery, veins, and nerves, constituting with them the cord. It lies behind the blood-vessels, and is readily distinguishable from them by its hard, cord-like feel. The direction of the spermatic cord is vertical from the testes upwards to the external abdominal ring; here it inclines obliquely outwards in the course of the inguinal canal. Arrived at the internal ring, the vas deferens turns away from the other vessels, and passes downwards into the pelvis. In descending, it runs along the side of the bladder, and passing anteriorly to the termi-

* Sir A. Cooper, loc. cit.

nation of the ureter, reaches the inner border of the vesicula seminalis, with whose duct it unites to form the common seminal or ejaculatory duct. The vas deferens is formed of an external peculiarly thick and dense substance, and an internal mucous lining membrane; the calibre of its canal is very minute, especially towards its commencement.

Vesiculæ Seminales.—The vesiculæ seminales (plates XXVI. XXVII.) are two narrow, membranous sacs, placed along the base of the bladder, and extended obliquely from the ureters to the base of the prostate gland. Their breadth is not more than three or four lines, their length two inches and a half. They converge anteriorly, and diverge behind, so as to include between them an angular space, in which the bladder rests immediately on the rectum. Each vesicula is convoluted, so as to appear much shorter than it really is, and consists of two lamellæ, the exterior one being dense and firm, whilst the internal is in every respect similar to mucous membrane, and thrown into folds, so as to divide the cavity into cells. The anterior extremity of the vesicula ends in a narrow tube, which unites with the vas deferens, forming a common duct.

The common seminal ducts (*ductus ejaculatorii*) result from the union of the vas deferens and the tube from the vesicula on each side. Each is about an inch in length. They run forward parallel one to the other, lying between the middle and two lateral lobes of the prostate, then between the latter and the mucous membrane,—piercing which, they open into the urethra, beside the margins of the sinus which exists at the anterior part of the veru montanum.

Vessels and nerves of the Testis.—The vessels and nerves of the parts which cover the spermatic cord and testis have been already described; it remains to point out those which are furnished to the organ itself.

Artery of the Vas deferens.—A long, slender branch, given off by a vesical artery, accompanies each vas deferens, ramifying in its coats, and hence named deferential.* It extends as far as the testis, and communicates with the vessel to be next noticed.

The *spermatic artery* is slender and remarkably long. In early fœtal life, the length is, however, no greater than ordinary, as at that period the testis is situated near the parts of the aorta from which the artery springs. The spermatic artery, as it approaches the testis, gives off small branches to the epididymis, then perforates the tunica albuginea, and ramifies in the vascular membrane to supply the tubuli seminiferi.

The *spermatic veins* commence by radicles from the different parts of the epididymis and testis; these unite into two or three vessels, which freely communicate one with the other, forming a sort of plexus. Following the course of the arteries, they unite in the abdomen into one trunk, which opens on the right side into the vena cava, and on the left side into the renal vein. The *lymphatics* consist at first of three or four vessels, which decrease in number as they ascend. They accompany the spermatic veins, and terminate in lymphatic glands, lying about the large vessels in front of the vertebral column.

The *nerves* are derived from the sympathetic system. The spermatic plexus follows the course of the spermatic artery to the testis. It receives some additional filaments, which accompany the artery of the vas deferens, from the hypogastric plexus.

Female Organs of Generation.—The genital organs in the female are divisible, as are those of the male, into two classes: 1, those of formation (*organa generationis*, vel *formationis*), consisting of the ovaries, uterus, and Fallopian tubes; and 2, those of copulation, viz. the vagina and vulva. We commence with the latter, as they are usually first examined.

Vulva, or *Pudendum*, is a general term, which is considered as including all the parts perceptible externally; they are also sometimes called external genital organs, and consist of the mons Veneris, the labia, the hymen or carunculæ, the clitoris, and the nymphæ. The orifice of the urethra is also noticed in connexion with them, but solely from its situation.

Mons Veneris.—The integument on the fore part of the pubic symphysis is elevated by a quantity of cellular and adipose substance deposited beneath it, and is studded with hair. This part, from its surmounting the labia, has been called mons Veneris. The *labia pudendi* (labia externa v. majora) extend downwards from the mons, gradually becoming thinner as they descend. They form two folds, so placed as to leave an elliptic interval (*rima*) between them, the external part of each being continuous with the skin of the thigh, and covered with scattered hairs, whilst the inner is lined by mucous membrane, forming the commencement of the genito-urinary mucous system. The labia unite both beneath the mons and before the perinæum, the points of union being called commissures; the inferior one has also received the name of *fourchette*. This is about an inch distant from

* Sir A. Cooper, loc. cit.

the margin of the anus,—the interval being named the perinæum. Immediately above and on the inner side of the lower commissure, the labia are connected by a slight transverse fold (*frænulum pudendi*); the space between it and the entrance of the vagina has been called *fossa navicularis*.

The *hymen* is a thin duplicature of the mucous membrane, placed at the lateral and inferior parts of the entrance of the vagina; its form varies very considerably in different persons, but is most frequently semi-lunar, the concave margin looking obliquely upwards. In the same situation are found, after the rupture of the membrane, some small rounded masses called *carunculæ myrtiformes*.

Clitoris.—Beneath the upper commissure, and within the labia, is the *clitoris*, a small elongated body, resembling in conformation and structure the diminutive of the penis: thus, it is sustained by two corpora cavernosa, separated by an incomplete septum, and attached by crura to the rami of the ossa pubis. It is also surmounted by a glans, though imperforate, from which depends a fold of membrane analogous to the prepuce, and acted on by a muscle.

Nymphæ—labia interna v. minora.—From the clitoris two folds of mucous membrane, in form not unlike a cock's comb, descend obliquely outwards, one on each side. These are the nymphæ. Their inner surface is continuous with that of the vagina, the external insensibly passes into that of the labia. They contain, between the laminæ of mucous membrane, a small quantity of erectile tissue, which appears continuous with that of the glans clitoridis.

The Vestibule.—Between the nymphæ, and beneath the clitoris, is an angular interval called vestibule, at the centre of whose base is situated a circular orifice leading to the meatus urinarius. The membranous fold which surrounds the orifice of the urethra is rather prominent in some instances, so as readily to indicate its situation. The urethra has been already described.

The *mucous membrane* may be traced inwards from the external labia, where it is continuous

PLATE XXX.

Female organs of generation, external and internal, with a side view of the viscera of the female pelvis.

Fig. 1. The external organs of generation of the adult female.

Nos. 1, 1. The mons Veneris. 2, 2. The labia majora. 3. The anterior commissure of the vulva. 4. The posterior commissure of the vulva. The elliptical area included within these limits is the vulva. 5. The perinæum. 6. The margin of the anus. 7. The fossa navicularis. 8. The clitoris. 9, 9. The præputium clitoridis. 10. The glans clitoridis. 11, 11. The labia minora, or nymphæ, losing themselves gradually upon the walls of the vulva. 12. The vestibule. 13. The tubercle of mucous membrane, which marks the situation of the orifice of the urethra. 14. The meatus urinarius. 15. The opening of the vagina. 16, 16. Carunculæ myrtiformes, bordering the entrance of the vagina.

Figs. 2, 3, 4, 5, represent various forms of the hymen.

Fig. 2. Nos. 1, 1. The hymen, consisting of a membranous septum perforated through its centre. 2. The vestibule.

Fig. 3. No. 1. The semilunar form of the hymen,—a membranous septum, incomplete in front, and having the concavity directed forwards. 2. The opening of the vagina. 3. The vestibule, perforated at its lower part by the meatus urinarius.

Fig. 4. No. 1. A vertical septum dividing the entrance of the vagina into two lateral openings. 2. The vestibule, with the meatus urinarius.

Fig. 5. No. 1. A transverse membranous septum, dividing the entrance of the vagina into an anterior and posterior opening; the latter being large and well defined, the former narrow and valvular. 2. The vestibule.

Fig. 6. A side view of the female pelvis, showing the position of the viscera.

No. 1. The prominence of fat which produces the elevation of the mons Veneris. 2. The cartilaginous surface of the symphysis pubis. 3. The rectus muscle attached to the upper part of the body of the os pubis. 4. The bladder, distended with fluid; the figure marks its body. 5. The fundus of the bladder, from which the peritonæum is reflected upon the internal surface of the abdominal parietes. 6, 6. The ureter of the left side. 7. The base of the bladder. 8. Its cervix. 9. The urethra. 10. The meatus urinarius. 11. The clitoris; the left crus is divided across. 12. The labium pudendi majus of the right side. 13. The entrance of the vagina. 14, 14. Carunculæ myrtiformes. 15, 15. The transverse rugæ of the vagina. 16. The os uteri projecting into the upper part of the vagina. 17. Its anterior lip. 18. Its posterior or longer lip. 19. The divided edge of the vagina, at its attachment to the cervix uteri. 20. The cervix, or neck of the uterus. 21. The body of the uterus. 22. The fundus of the uterus. 23. The left broad ligament of the uterus. 24, 24. The left Fallopian tube. 25. Its fimbriated extremity. 26. The convex surface of the left ovary, seen projecting below the cut border of the broad ligament. 27. The round ligament. 28. The duplicature formed by the passage of the peritonæum from the anterior surface of the vagina to the base of the bladder. 29. The posterior duplicature, formed by the peritonæum in passing from the anterior surface of the rectum to the posterior surface of the vagina. 30. The cavity of the peritonæum. 31. The upper portion of the rectum. 32. The middle portion of the rectum. 33. The inferior and terminal portion of the rectum. 34. The superficial sphincter ani muscle. 35. The anus. 36. Section of the last lumbar vertebra. 37, 37. Divided surface of a vertical section of the sacrum. 38. The coccyx.

Plate 30.

Fig 1.

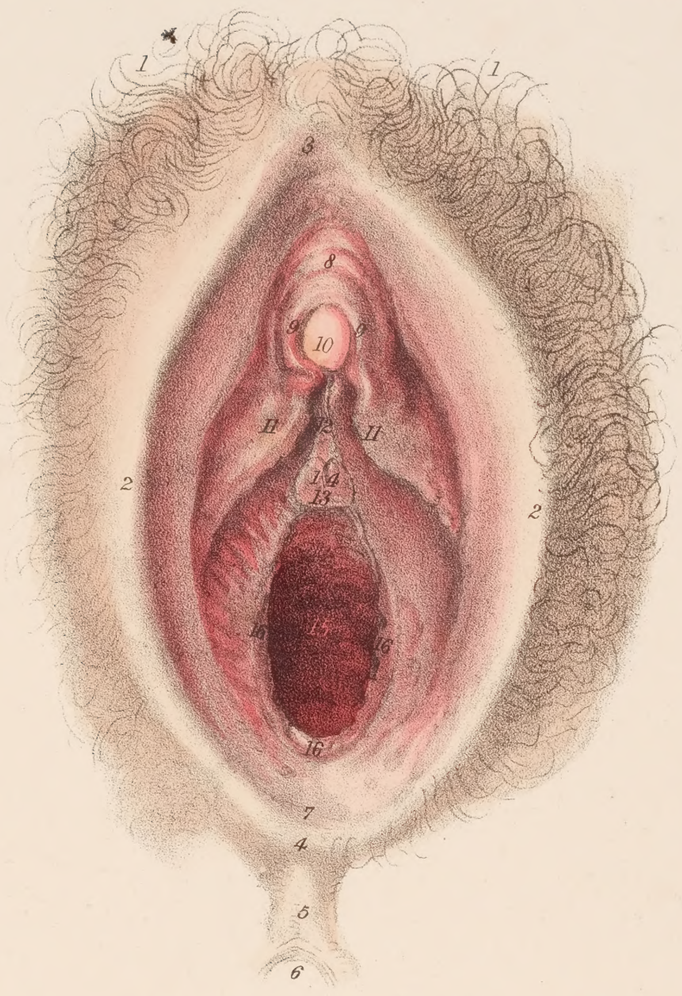


Fig 2.

Fig 3.

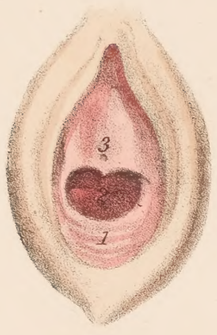


Fig 4.

Fig 5.

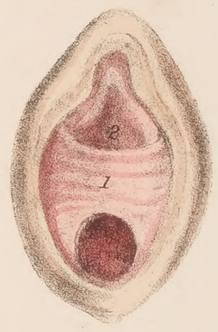
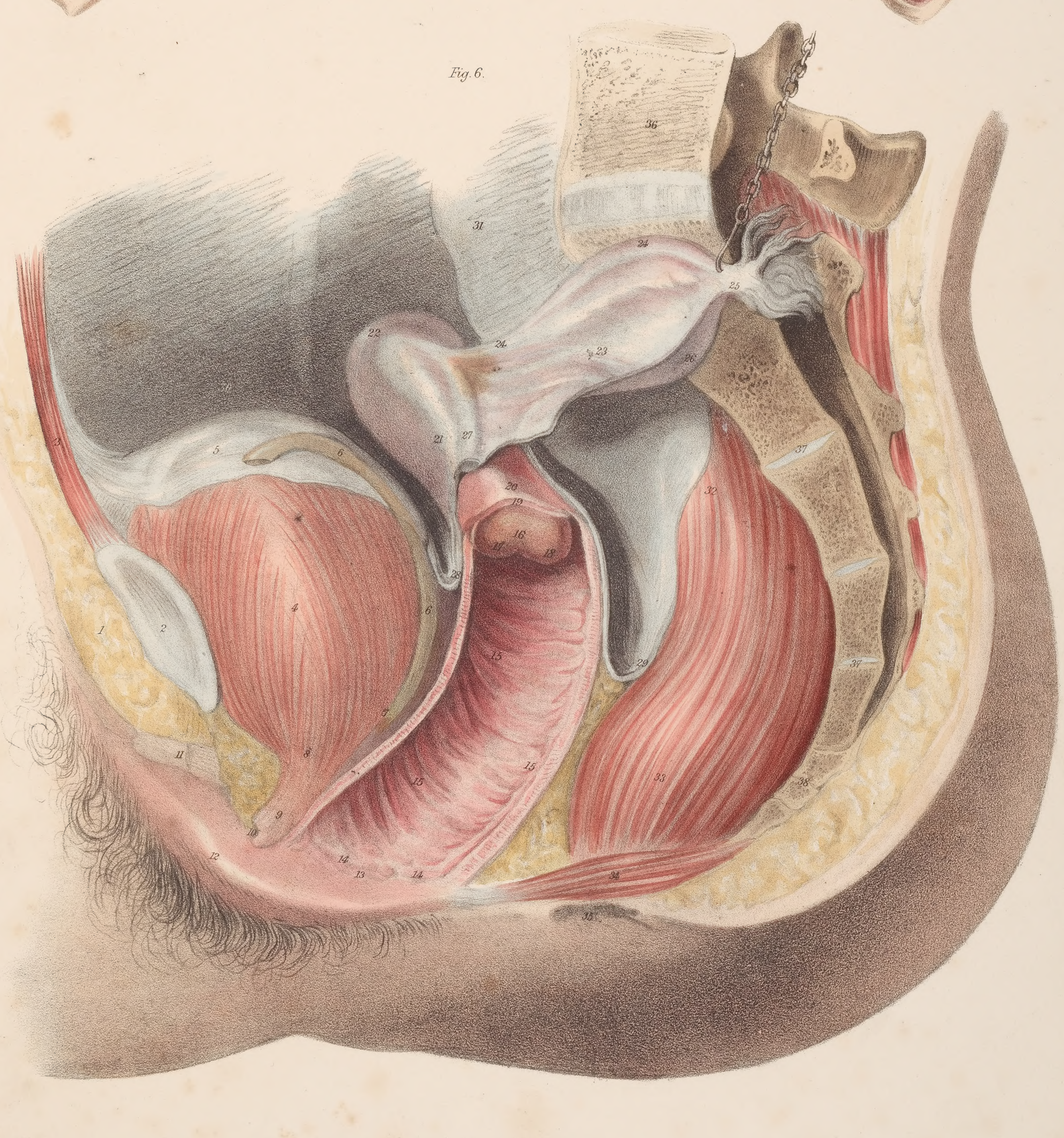


Fig 6.



Drawn from Nature by W. Bagg.

W.J. Erasmus Wilson direxit. London, Taylor & Walton, Upper Gower St. Wm Fairland litho

Plate 31.

Fig 1.

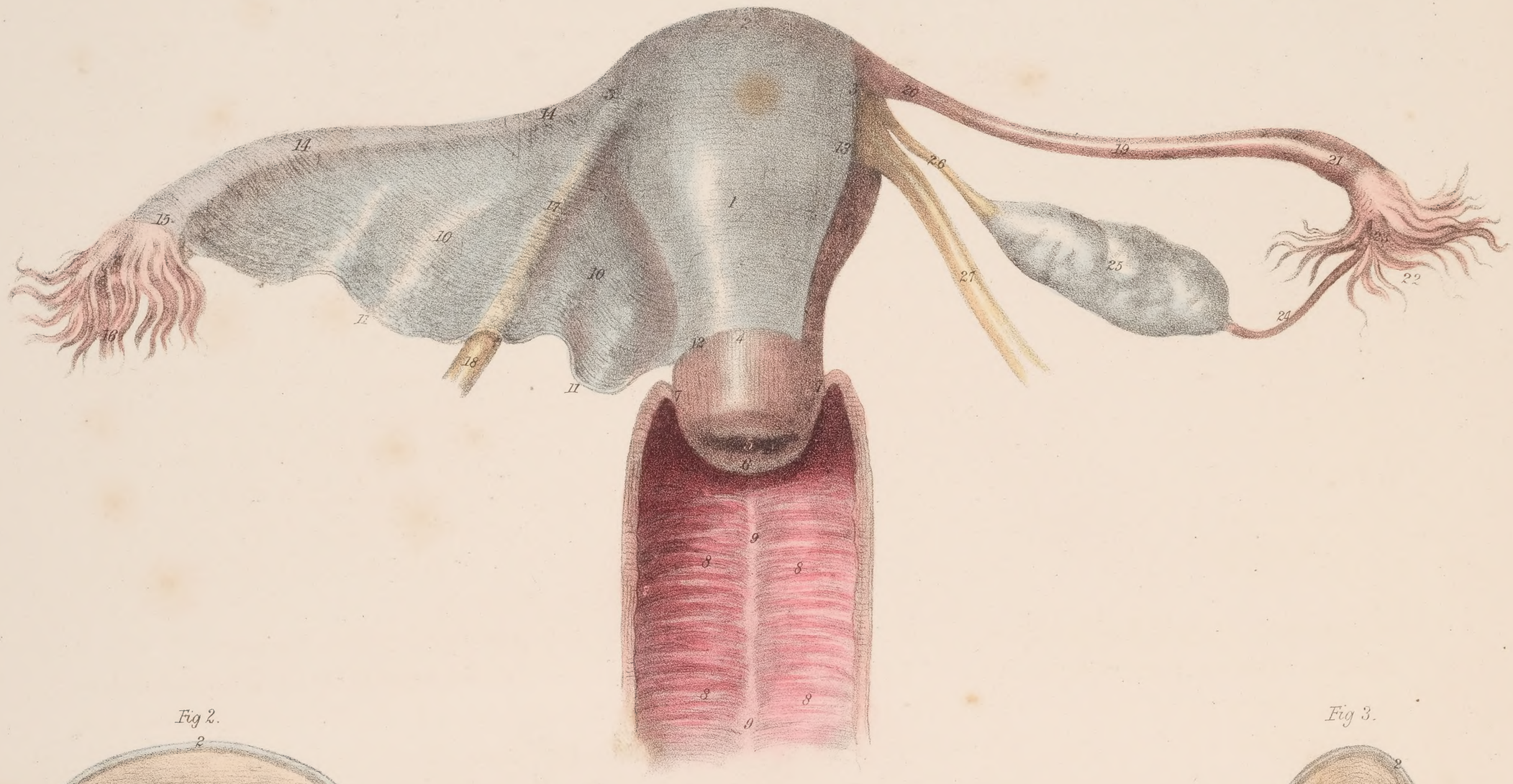


Fig 2.

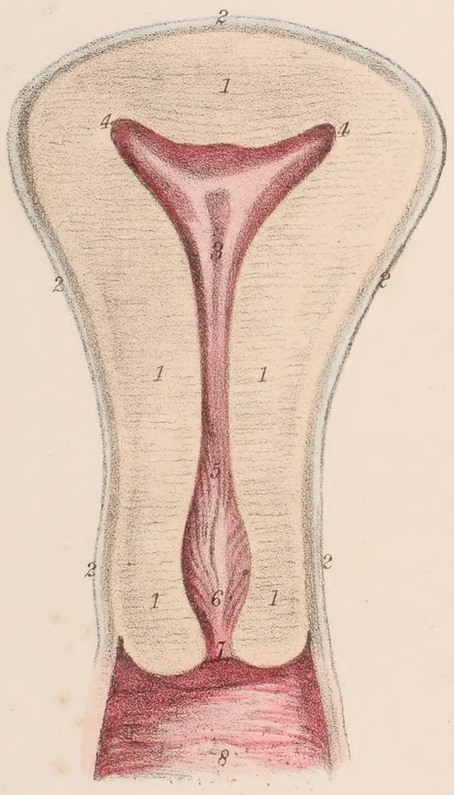


Fig 3.

Fig 4.

Fig 5.

Fig 6.

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with the skin : it forms the nymphæ by being folded on itself, and is prolonged into the urethra and vagina. It is reddish in colour, is covered by epidermis, and beneath it lie a considerable number of mucous follicles.

Vessels and nerves.—The parts here described are abundantly furnished with vessels and nerves. The arteries are the internal and external pudic. The veins and lymphatics correspond in their course with the arteries. The nerves proceed from the lumbar and the sacral plexus.

The Vagina. — The *vagina* is a membranous and dilatable tube extended from the vulva to the neck of the uterus, which it embraces ; it rests on the rectum, supports the bladder and urethra in front, and is enclosed between the levatores ani. Thus placed, it is oblique from below upwards and backwards, its axis corresponding with that of the outlet of the pelvis. It is also slightly curved, the concavity of the curve looking upwards. Hence its length will be found greater if measured on the lower than on the upper surface, being in the latter direction about four inches and a half, while in the former it amounts to six and a half or seven. The extremities of the vagina are somewhat narrower than the middle part : the inferior is surrounded by a constrictor muscle : the superior embraces the uterus at a greater height behind than in front, and is covered by peritonæum.

On the *inner surface* of the vagina, along the superior, as well as the inferior wall, a slightly elevated line extends from before backwards, similar to the raphé in the middle line in other situations. Several transverse lines (*rugæ*) will also be observed, particularly in persons who have not borne children, running at right angles with those just mentioned. The rugæ are but folds of the

PLATE XXXI.

The internal organs of generation of the female.

Fig. 1. An anterior view of the uterus and its appendages : on the left side the peritonæal layers constituting the broad ligament have been removed in order to show the parts included between them.

No. 1. The body of the uterus. 2. The fundus of the uterus. 3, 3. Its superior angles, with each of which the Fallopian tube, the round ligament, and the ligament of the ovary, are connected. 4. The cervix of the uterus. 5. The os uteri bounded by the anterior and posterior lips, of which the posterior, 6, is the most protuberant. 7, 7. The attachment of the vagina to the cervix uteri. 8, 8. The transverse rugæ of the mucous membrane of the vagina. 9, 9. The inferior columna of the vagina, to which the transverse rugæ proceed. 10, 10. The right broad ligament of the uterus, formed by two layers of the peritonæum. 11, 11. The cut edge of the broad ligament. 12. The cut edge of the anterior layer of the peritonæum, just before it passes forwards to the posterior surface of the bladder. 13, 13. The divided edge of the peritonæum covering the anterior surface of the uterus. The continuation of this layer outwards would have formed the anterior fold of the broad ligament of the left side, which has been removed. 14, 14. The Fallopian tube of the right side, situated in the upper and rounded border of the broad ligament. 15. The enlargement of the Fallopian tube near its terminal extremity. 16. The fimbriæ of the extremity of the Fallopian tube. 17. The round ligament of the right side, raising the anterior layer of the broad ligament into a convex ridge. 18. The round ligament separated from the duplicature of the broad ligament. 19. The Fallopian tube of the left side. 20. Its smaller extremity, connected with the superior angle of the uterus. 21. Its larger and more expanded extremity. 22. Its fimbriated extremity. 23. The opening (orificium abdominale) of the Fallopian tube seen by separating the fimbriæ. 24. One of the fimbriæ attached to the ovary. 25. The ovary of the left side. 26. The ligament of the ovary, attached to the upper angle of the uterus. 27. The round ligament of the left side.

Fig. 2. A vertical and lateral section of the uterus, showing the form of its internal cavity.

Nos. 1, 1. The substance of the uterus. 2, 2. The peritonæal covering of the uterus. 3. The cavity of the uterus. 4, 4. The openings leading into the Fallopian tubes. 5. The orificium internum of the uterus. 6. The dilated part of the cavity of the uterus corresponding with the cervix: this part of the organ is seen to be marked by ridges which have somewhat of an arborescent form, the arbor vitæ uterinus. 7. The orificium externum, or os uteri. 8. The upper part of the vagina.

Fig. 3. A vertical section of the uterus made in the antero-posterior direction.

Nos. 1, 1. The substance of the uterus. 2, 2. Its peritonæal layer. 3. The cavity of the uterus. 4. The constriction corresponding with the orificium internum uteri. 5. The dilated portion of the cavity corresponding with the cervix. 6. The orificium externum, or os uteri. 7. Section of the anterior lip of the os uteri. 8. Section of the posterior lip. 9. The upper part of the vagina.

Fig. 4. An uterus at the ninth month of pregnancy, turned inside out, so as to show its internal surface.—From Dr. Hunter's admirable work.

Nos. 1, 1. The ostium uterinum of each Fallopian tube, around which the enlarged fibres of the uterus are seen arranged in concentric circles. 2, 2. That portion of the uterus to which the placenta was attached: the enlarged muscular bands have a reticulated arrangement. 3, 3. The lower part of the body of the uterus, in which the muscular fibres are disposed in a circular direction. 4. A trace of the arbor vitæ uterina, nearly obliterated by the distension of the organ. 5. The os uteri.

Figs. 5 and 6. The ovary of a woman who died at the third month of pregnancy. On the surface of fig. 5 the cicatrix left by the rupture through which the ovum escaped, is seen. In the section of the same ovary, the corpus luteum, and the cavity originally occupied by the ovum, are perceived.

mucous membrane, and are calculated to admit of the elongation of the vagina that occurs during the ascent of the uterus in pregnancy.

The exterior layer of which the vagina is composed is cellulo-fibrous in its structure, and contracts a close connexion superiorly with the fibrous structure of the uterus. It is thin, firm, and of a pale red colour. Round the lower part of the tube a lamella of erectile tissue is placed, which diminishes gradually in quantity from thence upwards, so that near the uterus little or none can be discovered. The arteries of the vagina arise from the internal iliac. It is furnished with nerves from the cerebro-spinal and the sympathetic systems.

Uterus.—The uterus (the womb; matrix) is the largest of the genital organs, and is fitted to contain and support the new being during the period of fœtal life. It lies between the bladder and rectum, above the vagina, with which it is intimately connected, and enclosed in a fold of peritonæum, which, being extended laterally, connects it to the sides of the pelvis. In the ordinary condition, the uterus does not extend upward beyond the margin of the pelvis. The superior part inclines forwards, the inferior backwards; its direction thus corresponds to the upper axis of the pelvis, and forms an angle with that of the vagina. The average dimensions of the uterus may be stated to be about three inches in length, two in breadth superiorly, and one inch in thickness. The shape is somewhat triangular or pyriform, but compressed from before backwards, and is considered as presenting a fundus, a body, and a neck, with the enclosed cavity.

The *fundus* is the broad part which projects above the attachments of the Fallopian tubes, surmounting the body; it presents a convex border, and is covered by peritonæum in its entire extent. The *body* tapers gradually as it extends from the fundus to the neck, its two sides being straight; its surfaces, however, are both convex. At the union of the sides with the rounded superior border or base are two projecting angles, into which the Fallopian tubes are inserted, the round ligaments being a little before, and the ligaments of the ovaria behind and beneath them. The *neck* (cervix uteri) is continuous with the body, narrowing gradually to the extremity; it is from six to eight lines long, and projects into the cavity of the vagina, which is attached around, by its line of union with the body of the organ, but extends upwards to a greater distance behind than in front. This part is sometimes named vaginal (pars uteri vaginalis). Its extremity presents a transverse fissure, by which the cavity of the uterus communicates with the vagina; this is named variously—os uteri, os uteri externum, and (from some supposed likeness of the part to the mouth of the tench fish) os tincæ. It is bounded by two lips (*labia*), which are distinguished by their relative position into anterior and posterior, the latter being the thinner and longer.

The *cavity* is very small, in proportion to the size of the uterus. The part contained in the body of the organ is triangular, the base being directed upwards: at its two superior angles will be observed two minute foramina, which lead into the Fallopian tubes. Where the neck is continuous with the body, the cavity is slightly constricted: this point is, in consequence, sometimes named the internal orifice (os uteri internum). The portion which corresponds to the neck is more properly a canal; it is slightly dilated in the middle, and opens inferiorly into the vagina at the os tincæ. The inner surface is marked by two slightly raised longitudinal lines, which run, one on the anterior, the other on the posterior wall; in the neck are also seen some slight rugæ directed obliquely from the former, and thus presenting an appearance not unfrequently named arbor vitæ uterinus.

The *mucous membrane* which lines the uterus is so closely adherent to the proper substance of the organ, that its existence has been doubted by some anatomists; it is continued from the vagina, and into the Fallopian tubes. In the cervix, especially towards its lower part, there are several mucous follicles. There are also occasionally found in the same situation some small vesicular bodies which, from an erroneous opinion as to their nature, have been named ova (ovula, Naboth). They appear to be mucous follicles altered by diseased action.

Proper tissue of the uterus.—Though much difference heretofore existed concerning the nature of the proper tissue of this organ, it is now generally admitted to be muscular. The fibres are rendered distinct in cases in which the organ is enlarged, as during gestation, or when it contains a tumour. From the intricacy with which they interlace one with the other, it is difficult, if not impossible, to describe them more particularly than by assigning their general course. The muscular substance is most abundant towards the fundus of the uterus; the fibres are disposed in a longitudinal, a circular or transverse, and an oblique direction. The first appear to be the most numerous; those directed transversely are connected on each side with the Fallopian tubes and the round ligaments. The *outer surface* of the uterus has been already stated to be closely invested by the peritonæum.

Ligaments of the Uterus.—The *broad* ligaments.—The peritonæum, which covers the uterus on its anterior and posterior surfaces, is directed outwards to be connected to the sides of the pelvis. The

part intervening between the uterus and the pelvis, on each side, is called the broad ligament (ligamentum uteri latum). Each consists of a fold of serous membrane, between the laminæ of which are situated the ovary, the Fallopian tube, the round ligament, and some blood-vessels.

The peritonæum, where it is reflected off from the uterus, in front to the bladder and behind to the rectum, is sometimes also regarded as constituting anterior and posterior ligaments.

The *round ligaments* are cord-like fasciculi of fibres, attached to the angle of the uterus one on each side, immediately before the Fallopian tube. From this point the ligament passes upwards and outwards to reach the internal inguinal ring, and, after having passed through the canal of the same name, reaches the fore part of the pubic symphysis, where its fibres become expanded, and united with the substance of the labium and mons Veneris.

The *arteries of the uterus* are very tortuous, and are four in number, viz. the two ovarian (which correspond to the spermatic of the male) and the uterine. The former pass in between the folds which constitute the broad ligaments, give branches to the Fallopian tubes, the ovaria, and uterus, and anastomose with the other uterine vessels. The uterine arteries are derived from the internal iliac. They become insinuated beneath the peritonæum, supply vessels to the vagina, and ramify in the uterus. The *veins* and *absorbents* follow the course of the arteries.

Developement.—The uterus presents very considerable changes at different periods of life. In the fœtus it extends upwards into the abdomen, and is nearly vertical in direction. The situation and direction gradually altering, it assumes the position and inclination previously described. At the earliest period of developement it is divided superiorly into two distinct parts. The cornua, as they may be termed, gradually become united, and form an undivided organ with a single cavity. Such is the ordinary course; but cases occur in which the cornua remain permanently separate, constituting what is generally termed the double uterus. The state here referred to results from the non-union of the lateral halves, of which the upper part of the uterus originally consists. It is worthy of remark, that this condition is permanent in some inferior animals.

Subsequently to the period first mentioned, (after the lateral parts become united,) the uterus is nearly cylindrical, being of equal dimensions at its upper and lower extremities. The fundus, however, gradually increasing in breadth, the uterus assumes the pyriform shape, which is not completed till about the age of puberty. In old age the organ loses the triangular form, and becomes irregularly cylindrical, at the same time that it increases much in density.

During gestation, besides the remarkable increase of size and consequent change of situation, the muscular fibres become more perceptible; the arteries, veins, and lymphatics are greatly enlarged; the nerves, too, become more apparent. The substance of the organ is increased in thickness (to an inconsiderable degree) in the first instance, but, as the time of parturition approaches, it is somewhat thinner than in the unimpregnated condition.

Ovaries.—The ovaries (*ovaria*) are two compressed and irregularly oval bodies, somewhat granulated on the surface, and enclosed between the folds of the broad ligaments. From the internal extremity of each descends a fibrous cord (the *ligament of the ovary*), which attaches it to the angle of the uterus, behind the insertion of the Fallopian tube,—by one of the fimbriæ of which the outer extremity is supported. The ovarium is enclosed in a proper capsule, which is a thin cellulo-fibrous membrane; its proper structure presents, when divided, the appearance of a firm yet vascular mass giving lodgment to some small vesicles (*ovula Graafiana*). These, in females who have not had children, vary in number from about eight to fifteen or twenty.

The *Fallopian tubes* may be considered as the excretory ducts of the ovaria, before and a little beneath which they are situated; they are about three inches in length. The attached extremity of each tube is narrow and cord-like; the unattached or free extremity is broad, and divided into a number of irregular processes (*fimbriæ*), one of which is longer than the rest, and attached to the corresponding ovarium. The fimbriated border presents a fissure or opening (*ostium abdominale*), into which the impregnated ovum is received at the moment of its liberation from the ovarium, and thence conveyed along the tube, which opens into the uterus by another aperture (*ostium uterinum*). At this point it may be observed, that the serous membrane is in a manner continuous with the mucous, and consequently must be considered as interrupted, inasmuch as there is a real hilus along the fissured edge of the tube. Between the external serous covering and the lining membrane the tubes are composed of a thin layer of erectile tissue. The contained canal is very minute, particularly near the point at which it communicates with the uterus.

Mammary Glands.—The mammary glands (*mammæ*) are accessory organs to the genital system, and, when fully developed after puberty, present the appearance of two rounded eminences placed one at each side on the front of the thorax, resting on the pectoral muscles. The base of the mamma is

not exactly circular: it is rather ovoid or elliptical, the long diameter being directed obliquely upwards and outwards. A little below the centre of each projects a small conical body called the nipple, on which open several foramina that lead from the lacteal ducts. A coloured circle, or areola, surrounds the nipple, within which the skin is of a darker tinge than elsewhere. Beneath the skin is deposited, in most cases, a considerable quantity of adipose substance, which surrounds the proper substance of the gland.

Structure.—The mamma is a conglomerate gland, for it is found to consist of several small lobes, each being an aggregate of a number of lobules (acini). Each lobule is about the size of a millet seed, oblong in its form, and hollow; its elements or components may be said to be a mucous lining, and an envelope of cellular tissue, in which the secreting vessels ramify. From the lobules thus formed arise the minute radicles of the lactiferous tubes (*tubuli lactiferi*), which receive the secretion when elaborated. The tubes converge towards the nipple, so as to become collected into a fasciculus beneath it, in which situation they are supported by some firm cellular tissue:—the number varies from twelve to fifteen, and each is found to belong to a particular lobe of the gland; its incipient radicles or branches commencing from the interior of the lobules which form it. In this way four, six, or eight minute ducts unite to form one lactiferous tube, which inclines towards the areola, where it dilates somewhat, particularly during the period of lactation; but at the base of the nipple it narrows again, and runs in a straight course from its base to its summit, where it terminates. The tubes are lined throughout by a tegumentary membrane (mucous), which extends inwards from the minute orifices in the nipple, and permeates their entire extent, even to the lobules; and this inner lining appears to be enclosed in another tunic, formed of condensed cellular tissue.

Upon the surface of the areola and nipple several minute orifices open, which lead into sebaceous follicles, the secretion of which exudes upon the skin, to protect it from irritation.

PLATE XXXII.

The anatomy of the mammary gland.

Fig. 1. The virgin mamma of the left side: from a young woman twenty years of age.

Fig. 2. The right mamma of a pregnant woman thirty-eight weeks after conception.—From Dr. Montgomery's work, entitled "An Exposition of the Signs and Symptoms of Pregnancy, the Period of Human Gestation, and the Signs of Delivery."

In this mamma the larger size of the organ, as contrasted with the virgin mamma, will be remarked; the larger size, wrinkled and papillous appearance of the nipple; the greater circle, and deeper colour of the areola; and the large size and tuberculous aspect of the sebaceous follicles dispersed upon the areola. The enlarged veins meandering over the mamma, and rendered visible by their bluish tracks through the integument, are also characteristic of the period.

Fig. 3. The right mamma of a woman twenty-eight years of age, at the period of three weeks after delivery. The nipple, with the areola, are copied from the Atlas of Sir Astley Cooper's splendid work "On the Anatomy of the Breast;" the rest of the mamma was drawn from nature.

In explanation of the nipple and areola of this figure, Sir Astley Cooper writes, "Lactation three weeks after delivery, nipple extremely papillous, areola much extended, measuring two inches, tubercles appear upon various parts of the areola. Milk could not be pressed from the tubercles when the orifices of the nipple were closed and the breast compressed." The more tumid appearance of the breast, and the greater transparency of the integument, will be remarked. The veins are larger in size, and more distinctly perceived through the skin.

Fig. 4. From Sir Astley Cooper's splendid work, "The papillæ of the nipple (magnified to double their natural dimensions); showing their foliated appearance towards their summits, and the circles which they form towards the areola."

Fig. 5. From Sir Astley Cooper's splendid work.—"The nipple and the straight ducts, twenty-one in number."

Fig. 6. From Sir Astley Cooper's splendid work.—"Lactiferous tubes, or ducts, injected with red wax; showing their radiated direction, and, in some places, their inter-ramification."

Fig. 7. From Sir Astley Cooper's splendid work.—"A section of the breast at twenty years of age; showing the skin, the fascia, the ligamenta suspensoria, and the fat between them."

No. 1. The nipple. 2, 2. The integument. 3, 3. The ligamenta suspensoria: the interspaces of these ligamentous bands are occupied by adipose tissue. "It is," writes Sir Astley Cooper, "by these processes that the breast is suspended in its situation, and I shall therefore call them the *ligamenta suspensoria*."

"By these processes the breast is slung upon the fore-part of the chest, for they form a moveable but very firm connexion with the skin, so that the breast has sufficient motion to elude violence; yet by this fibrous tissue it is, excepting under age, lactation, or relaxation, prevented from much change of place."

4. The mammary gland. 5. The cellular tissue interposed between the mammary gland and the surface of the muscles of the chest. 6, 6. The pectoralis major muscle.

Fig. 8. From Sir Astley Cooper's splendid work.—Shows the origin of the lactiferous ducts from the milk-cells: the cells with their ducts are magnified four times.

Plate 32.

Fig. 1

Fig. 2.

Fig. 3.

Fig. 4.

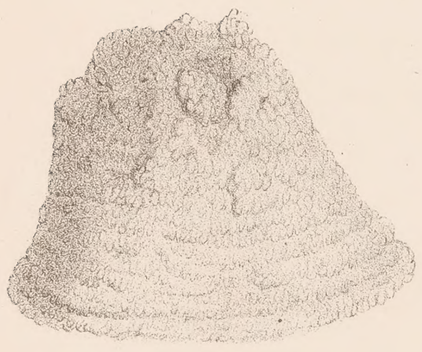


Fig. 5.

Fig. 6.

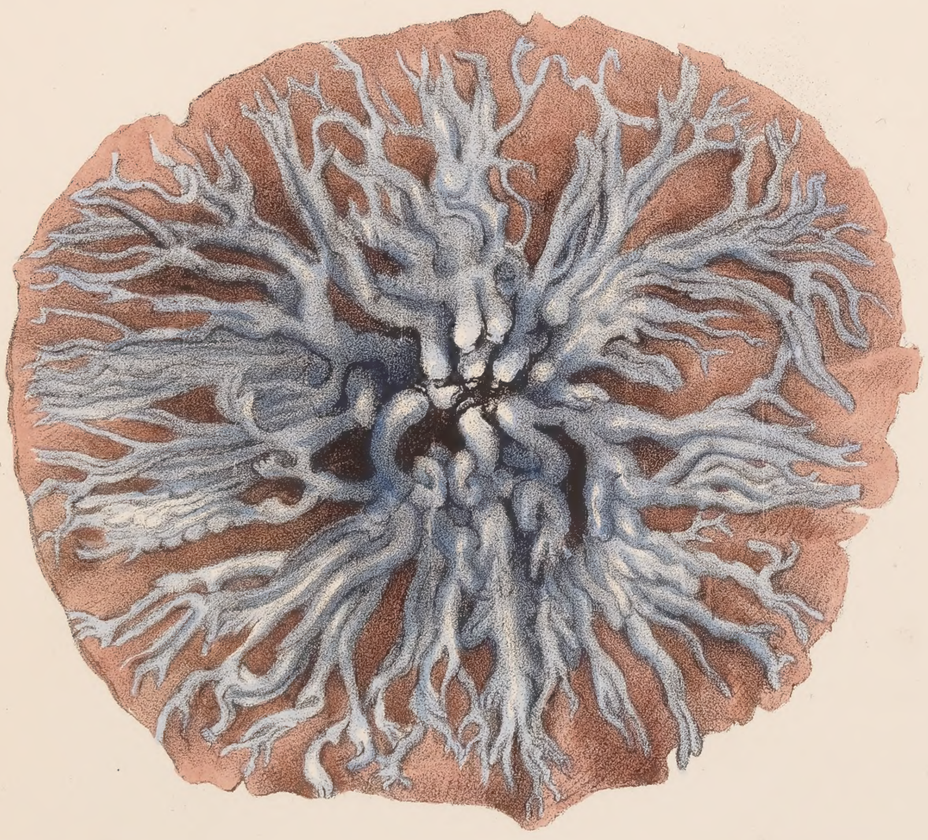
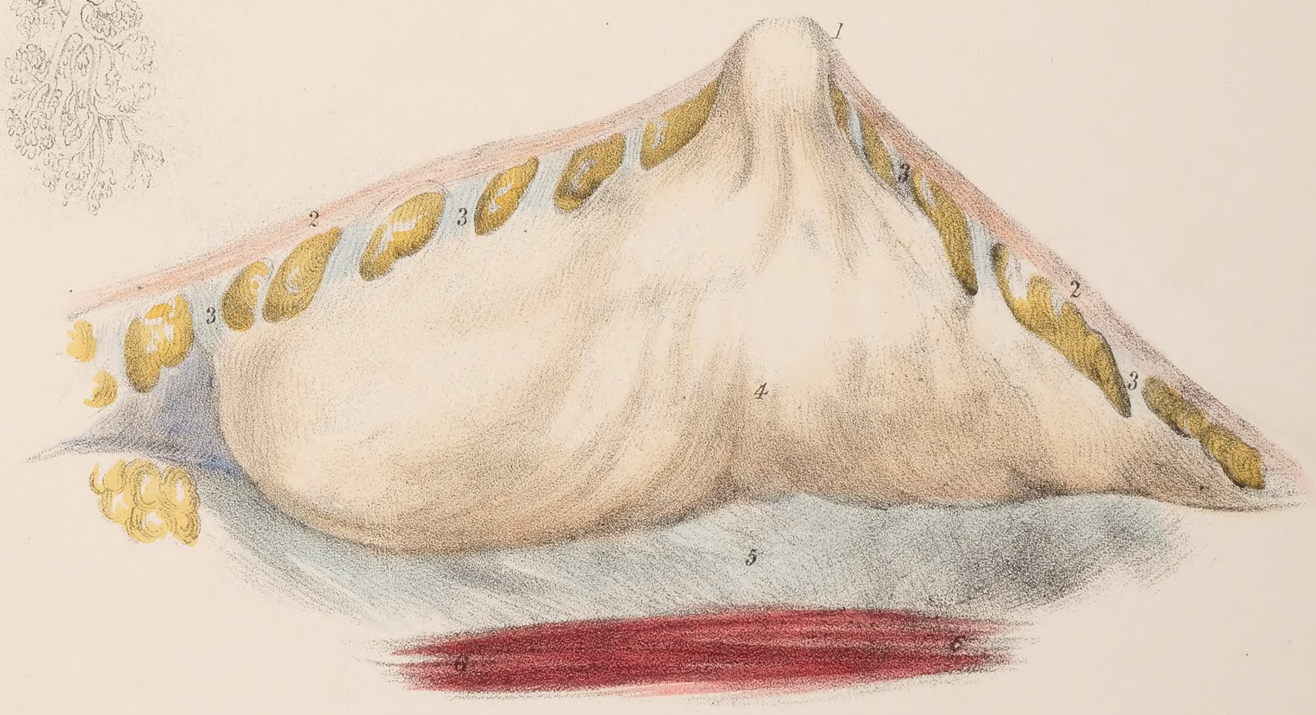


Fig. 8.

Fig. 7.



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END OF THE FOURTH DIVISION.

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